**TECHNICAL COMMENTARY ON PART R15 AND PART R15 ATTACHMENT A**

**SUPPLY OF PAVEMENT MATERIALS**

The following notes are intended to provide guidance to DPTI personnel and others on the application of this specification. They do not form part of the contract.

Cited information is listed at the end of this document.

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| **CONTENTS**  1. GENERAL  2. QUALITY REQUIREMENTS  3. ACCEPTANCE OF MATERIAL  4. QUALITY OF MATERIALS  5. SAMPLING AND TESTING  6. RECYCLED MATERIALS AND BLAST FURNACE SLAG  7. PERFORMANCE BASED PAVEMENT MATERIALS  8. STABILISED AND WET-MIXED MATERIALS (Plant Mixed)  9. RAIL BALLAST  10. ASPHALT AGGREGATES AND SAND  11. HOLD POINTS  12. VERIFICATION REQUIREMENTS AND RECORDS  Attachment R15A: Pavement Material Specification GENERAL  * + 1. This Part specifies the requirements for the supply and delivery of materials (including crushed quarry products, natural gravel, sand and recycled pavement materials) to be used in the construction of roadworks, bridgeworks, railways and other applications associated with construction.     2. The following definitions apply to this Contract:   **“Pavement Materials”** include:   * Spalls * Road Ballast * Rail Ballast * Class 3 Recycled Pavement Material * Class 3 Quarried Pavement Material * Class 2 Recycled Pavement Material * Class 2 Quarried Pavement Material * Class 1 Recycled Pavement Material * Class 1 Quarried Pavement Material * Stabilised Pavement Material * Sealing Aggregate * Sand * Asphalt Aggregate * Mineral Filler for Asphalt, other than Hydrated Lime * Arrestor Bed Material   **"Process Control"** means a controlled documented system of practices and procedures used to monitor and control the product inputs, equipment and manufacturing processes to ensure the product replicates the product design.  **"Secondary Mineral"** means a mineral which has formed as a consequence of the alteration or replacement (other than by the conditions of normal weathering) of a pre-existing material and without alteration to the form of the rock.  The following abbreviations apply to thie Contract:   |  |  | | --- | --- | | AS 1141 | Sampling and Testing Aggregates. | | AS 1289 | Methods for Testing Soils for Engineering Purposes. | | AS 2758 | Aggregates and Rock for Engineering Purposes. | | AS/NZS 2891 | Methods of Sampling and Testing Asphalt | | AS 1152 | Specification for Test Sieves | | NATA | National Association of Testing Authorities, Australia. | | RMS Txxx | Roads and Maritime Services NSW Test Procedure xxx. | | TP | Department of Planning, Transport and Infrastructure (DPTI) Test Procedure(refer http://www.dpti.sa.gov.au/materials\_technology\_documents/test\_procedures2). |  * + 1. The products must comply with the requirements specified in Attachment R15A available from:  http://www.dpti.sa.gov.au/documents/contractsandtenders/specifications\_-\_division\_R\_roadworks     2. If recycled materials are to be used for any purpose other than construction of roadworks for the Commissioner of Highways, additional environmental requirements may be necessary. These requirements are not contained within this Part.  QUALITY REQUIREMENTS**Quality Plan, Procedures and Documentation**  * + 1. Further to the requirements of Part G20 "Quality System Requirements", the Contractor must develop and implement a Quality Plan that includes the following procedures at a minimum:  |  |  | | --- | --- | | All materials: | * Random selection of sample increments (vide Clause 5 under "Sampling"). * Representative splitting of bulk samples (vide Clause 5under"Sampling"). * Handling and storage of the product including the avoidance of intermixing, contamination or deterioration which may affect the product properties. * Inspection of bins, stockpile pads and trucks for contamination and operational efficiency * Requirements for inspection and testing of processes and products (including the Inspection and Test Plan, vide Clause G20.7 "Inspection and Testing") | | Material sourced from Quarries | * Plant calibration and maintenance, including weighing equipment, flow meters and proportioning systems where installed * Primary, Secondary and Tertiary Crusher inspection, wear adjustment and maintenance * Screen Deck inspection, wear adjustment and maintenance * Use and handling of explosives. * Assessment of quarry face and shot rock * Moisture control of shot rock * Handling processes for shot rock * Requirements for labelling of storage bays and silos | | Sealing aggregate: | * Stripping performance (vide Clause 4 under "Aggregate Stripping TP705"). | | Asphalt Aggregates | * Additional process control elements (vide Clauses 2 and 10). | | Basic igneous source rock | * Control of secondary mineralisation (vide Clause 4 under “Secondary Mineralisation"). | | Recycled materials and Blast Furnace Slag | * Control of constituent materials (vide Clause 6 under "Construction and Demolition Materials" or “Blast Furnace Slag”) as applicable. * Quality Control and Compliance Testing (vide Clause 6 under “Alternative Sources of Recycled Materials”). | | Stabilised materials | * Control of binder content (vide Clause 8 under "Additive Content Determination"). * Use of retarder (vide Clause 8 under "Addition of Retarder"). * Working time for other binders (vide Clause 8 under "Time Requirements"). |      * + 1. Where the Principal does not hold a copy of the current procedures, these procedures must be submitted at least 28 days prior to the commencement of production and must generate objective evidence that the specified quality requirements have been achieved.     2. Provision of the documentation listed in this Clause shall constitute a **hold point**.  **Asphalt Aggregates**  * + 1. The Contractor must develop and implement a Process Control System for the production of Asphalt Aggregates. The documentation must include a description of the flow of materials and the processes carried out on them from input materials to the plant through to delivery of aggregates to the customer. It must incorporate a flow diagramand identification of the key elements of the manufacturing process requiring monitoring, measurement or verification. Constant monitoring and statistical analysis of records to verify process capability and product characteristics must be undertaken.  **Identification**  * + 1. In addition to the requirements of Clause G20.6 under "Identification", the pavement materials must be produced in identifiable Lots not greater than the following:  |  |  | | --- | --- | | Sealing and Asphalt Aggregates, Arrestor Bed Material: | 500 tonnes | | Other Pavement Materials: | 1 000 tonnes. |  * + 1. A Lot of the material must be produced under uniform conditions from the same source material and/or the same constituent components and be essentially homogeneous with respect to composition and general appearance. Notwithstanding Clause G20.6.1 “Definition”, a lot may be prepared from more than one day’s production.  **Dedicated Stockpiles**  * + 1. The Contractor must establish dedicated stockpiles conforming to the following requirements:        - 1. The location of each Lot must be accurately identified until conformance of the Lot with the Specification requirements has been verified.          2. Any non-conforming Lots placed into these stockpiles must be removed.          3. Where the stockpile contains more than one Lot, the stockpile must be constructed in horizontal layers with each successive layer fully contained within the area of the upper surface of the preceding layer. Levelling of each layer must be carried out in a manner to minimise segregation and material breakdown.          4. Once a dedicated stockpile has been completed, further material must not be added to the stockpile.  ACCEPTANCE OF MATERIAL  * + 1. Acceptance of materials will be undertaken on a Lot basis and the total quantity of material in the Lot will be subject to acceptance or rejection. The material in a Lot will be accepted if the material has been produced and stockpiled in accordance with the Specification and the NATA endorsed test results for the bulk sample comply with the requirements specified.  QUALITY OF MATERIALS**General**  * + 1. All material must be clean, sound, hard and durable.     2. Mica, shale and similar laminated materials, adherent coatings or any foreign material must not be present in form or sufficient quantity to produce adverse effect upon the usage and performance of the material.     3. All products must be produced from natural rock or sand deposits, as appropriate, except where otherwise permitted in this Part.     4. Recycled materials and blast furnace slag must conform to the requirements detailed in Clause 6 "Recycled Materials and Blast Furnace Slag", which are specific to use in roadworks. All materials must be free from undesirable seeds as described in the regulations under the Natural Resource Management Act The regulations are available from http://www.legislation.sa.gov.au/index.aspx/.  **Properties**  * + 1. Materials supplied must comply with the requirements specified in the Product Specification Sheets (Attachment R15A). Additive contents must be within the tolerances stated in Clause 8 under "Additive Content Determination" in the case of Plant Mixed materials.     2. For all materials specifications, square aperture sieves conforming to AS 1152 "Specification for Test Sieves" must be used for the determination of grading for particle sizes 75 mm and finer. Coarser sizes must be determined by linear measurement.  **Aggregate Stripping (TP 705)**  * + 1. The Contractor must:        1. Implement a design process to prevent the adverse stripping performance of sealing aggregates;        2. Include a procedure for determining the stripping performance of the sealing aggregates in both wet and dry states in the Quality Plan;        3. Include pre coating agents and adhesion agents in the testing program; and        4. Report the wet and dry test results.  **Secondary Mineralisation**  * + 1. This clause applies where basic igneous source rock (as defined in AS2758) is used for the production of a Pavement Material complying with this Part R15.     2. Secondary mineralisation must not be present in the Pavement Material to the extent that it adversly affects the Pavement Material’s durability and/or long term performance.     3. The Quality Plan must:        - 1. indicate the level and nature of secondary mineralisation of the source rock, including a description of the potential of the secondary mineralisation to cause material degradation;          2. include procedures for monitoring the quality of the product and component materials during quarrying and production, addressing the control and monitoring of secondary mineralisation          3. include rock type and durability classifications (ie Sound, Marginal or Unsound Rock) provided by Vicroads in accordance with Vicroads Specification 801 "Source Rock for the Production of Crushed Rock and Aggregates"; and          4. address any other information reasonably requested by the Principal.     4. Vicroads Specifications are available from http://webapps.vicroads.vic.gov.au/VRNE/csdspeci.nsf/.  SAMPLING AND TESTING**Sampling**  * + 1. Unless specified otherwise, the Contractor must arrange for sampling of material to be carried out by an appropriately NATA certified laboratory in accordance with TP 226 "Sampling of Soils, Aggregates and Rock".     2. The Contractor must include in the Quality Plan procedures for the random selection of sample increments appropriate to the sampling method used and the process of splitting and recombining to produce two samples equally representative of the bulk sample.     3. Preparation of samples for testing will be undertaken in accordance with AS 1289.1     4. Unless otherwise approved, the NATA laboratory must split each bulk sample to produce an audit sample to be held by the NATA certified laboratory for a period no less than 14 days after submission of test results.     5. Audit samples for Sealing Aggregates must be held until the end of the Defects Liability Period and supply the sample if requested.  **Testing**  * + 1. Notwithstanding TP 226 "Sampling of Soils, Aggregates and Rocks" and Clause 6.1.1 "General" therein, Quality Control testing for each product must be undertaken on a sample representing each production Lot.     2. The Quality Control tests listed on each Product Specification Sheet (Attachment R15A) must be performed on the sample representing each Lot in accordance with the testing frequency specified in Table 5.7:  |  |  |  |  | | --- | --- | --- | --- | | **TABLE 5.7 QUALITY ASSURANCE MINIMUM TESTING FREQUENCIES** | | | | | **TEST PROCEDURE** | **PROPERTY** | | **MINIMUM TEST FREQUENCY \*** | | **SPALLS** | | | | | AS 1141.11 | Particle Size Distribution | | One test per 5 Lots | | **ROAD BALLASTS** | | | | | AS 1141.11 | Particle Size Distribution | | One test per 5 Lots | | AS 1141.23 | Los Angeles Value | | One test per 5 Lots | | **RAIL BALLAST** | | | | | AS 1141.4 | Bulk Density | | Two tests 1st per Lot, One test per Lot thereafter | | AS 1141.6.1 | Particle Density | | Two tests 1st per Lot, One test per Lot thereafter | | AS 1141.11 & 12 | Particle Size Distribution | | Two tests 1st per Lot, One test per Lot thereafter | | AS 1141.22 | Wet/Dry Strength | | Two tests 1st per Lot, One test per Lot thereafter | | AS 1141.23 | Los Angeles Value | | Two tests 1st per Lot, One test per Lot thereafter | | AS 1141.14 | Mis-shapen Particles | | Two tests 1st per Lot, One test per Lot thereafter | | **QUARRIED PAVEMENT MATERIALS** | | | | | TP134 | | Particle Size Distribution | One test per Lot | | AS 1289 3.1.2 ,3.2.1, 3.3.1 & 3.4.1 | | Atterberg Limits | One test per Lot | | AS 1141.23 | | Los Angeles Value | One test per Lot3 | | TP183 | | Resilient Modulus/Deformation | One test per 100 Lots (Performance based only). | | TP184 | | Triaxial Compression | One test per 100 Lots (Performance based only). | | **RECYCLED PAVEMENT MATERIALS** | | | | | TP134 | | Particle Size Distribution | One test per Lot | | AS 1289 3.1.2, 3.2.1, 3.3.1 & 3.4.1 | | Atterberg Limits | One test per Lot | | RMS T276 | | Foreign Materials Content | One test per Lot | | AS 2891.3.3 | | Bitumen Content | One test per Lot3 | | AS 1141.23 | | Los Angeles Value | One test per Lot3 | | Contaminants | | Metals, Organics | In accordance with Contractor’s approved quality control and compliance testing procedures | | TP183 | | Resilient Modulus/Deformation | One test per 100 Lots (Performance based only). | | TP184 | | Triaxial Compression | One test per 100 Lots (Performance based only). | | **STABILISED PAVEMENT MATERIALS** | | | | | TP134 | | Particle Size Distribution | One test per Lot | | AS 1289 3.1.2, 3.2.1, 3.3.1 & 3.4.1 | | Atterberg Limits | One test per Lot | | AS 1141.23 | | Los Angeles Value | One test per Lot3 | | Contractor Quality Plan | | Binder Content | One test / 150 tons (refer Clause 8 under “Additive Content Determination”) | | AS 1141.51 | | UCS (Strength Control) | Two tests/150 tons (refer Clause 8 under “Strength Determination Testing”) | | AS 1141.51 | | UCS (Binder Content Control) | One test per 10 000 tons | | **SEALING AGGREGATES** | | | | | AS 1141.11 | | Particle Size Distribution | One test per Lot | | AS 1141.15 | | Flakiness Index | One test per Lot | | TP244 | | % Flat Particles | One test per Lot | | AS 1141.14 | | Mis-shapen Particles | One test per Lot | | AS 1141.23 | | Los Angeles Value | One test per Lot3 | | AS 1141.42, AS 1141.40 | | Polished Aggregate Friction | One test annually2 | | TP705 | | Aggregate Stripping | One test annually2 | | AS 1141.20.1 or 20.2 | | Average Least Dimension - direct | Three tests per Lot | | AS 1141.20.3 | | Average Least Dimension - calculated | One test per Lot | | **ASPHALT AGGREGATES** | | | | | AS 1141.11 | | Particle Size Distribution | One test per Lot | | AS 1141.15 | | Flakiness Index | One test per Lot | | TP240 | | Elongation Index | One test per Lot | | AS 1141.23 | | Los Angeles Value | One test per Lot3 | | AS 1141.5, AS 1141.6.1 & AS 1141.6.2 | | Water absorption & densities | One test per 10 Lots | | AS 1141.24 | | Sulphate Soundness | One test per 10 Lots3 | | AS 1141.30 | | Unsound & marginal stone contents | One test per Lot1,3 | | AS 1141.42, AS 1141.40 | | Polished Aggregate Friction | One test annually2 (refer Clause 10) | | **SANDS** | | | | | TP134 | | Particle Size Distribution | One test per Lot | | AS 1289 3.1.2 , 3.2.1, 3.3.1 & 3.4.1 | | Atterberg Limits | One test per Lot3 | | AS 1141 34 | | Organic Impurities | One test per Lot3 | | **MINERAL FILLER FOR ASPHALT, OTHER THAN HYDRATED LIME** | | | | | AS 1141.11 | | Particle Size Distribution | One per contract | | AS 1141.17 | | Voids in Dry Compacted Filler | One per contract | | AS 1289.B1.3 | | Moisture Content | One per week | | AS 2350.8 | | Specific Surface | One per contract | | AS 3583.3 | | Loss on Ignition | One per contract | | AS 1141.8 | | Water Soluble Fraction | One per week | | **ADDITIONAL REQUIREMENTS FOR BASIC IGNEOUS SOURCE ROCK** | | | | | AS1142.6 | | Secondary Mineral Content | One test every two years | | AS 1141.29 | | Accelerated Soundness Index | One test every two years | | AS 1141.30 | | Unsound & marginal stone contents | Three tests per Lot | | **ARRESTOR BED MATERIAL** | | | | | TP134 | | Particle Size Distribution | One test per Lot | | RMS T239 | | Fractured Faces | One test per Lot | | AS 1141.14 | | Mis-Shapen Particles | One test per Lot | | WA 223.1 | | Crushing and Cracking | One test per contract | | AS 1141.23 | | Los Angeles Value | One test per Lot | | WA Specification 6706/02/1312 Attachment | | Slump Angle | One test per Lot | | AS 1141.4 | | Bulk Density | One test per contract |   1 Testing for Unsound & marginal stone contents under “Additional Requirements for Basic Igneous Source Rock”, (if required) will include this test in the total number required per Lot.  2 The Principal reserves the right to obtain material and undertake annual testing as necessary.  3 Refer Clause 5 under “Reduced Rate of Testing” for more information.  \* Refer to the Clause listed for further information about the testing frequency. **Reduced Rate of Testing**  * + 1. The Contractor may adopt a reduced frequency of testing where approval has been granted under Part 4 of the Guidelines for the DPTI Prequalification Scheme for the Supply of Pavement Materials. Refer: http://www.dpti.sa.gov.au/contractor\_documents/prequalification.     2. Subject to Part 4 of the Guidelines, the Contractor may apply for a reduced frequency of testing for this Contract. Acceptance of a reduced rate of testing does not derogate from the Contractor’s obligation to provide conforming Pavement Material.  RECYCLED MATERIALS AND BLAST FURNACE SLAG  * + 1. This Part does not consider the suitability of recycled materials or blast furnace slag for any other purpose than use in DPTI roadworks. Where Quarried Material has been specified in **Contract Specific Requirements “Pavement Work”,** the Contractor may submit a proposal to use Recycled Material or Blast Furnace Slag in lieu of Quarried Material.     2. Blast Furnace Slag used in lieu of Quarried Materials referred to in this clause is for Blast Furnace Slag only and must not be granulated or ground.     3. Submission of the proposal shall constitute a **hold point**.  **Construction and Demolition Materials**  * + 1. Recycled products comprising blends of quarried material and/or reclaimed concrete, with or without supplementary source materials (brick, tile and asphalt) must comply with the designated quality requirements for each recycled product detailed in Attachment R15A.     2. No more than 20% by mass of supplementary materials must be incorporated and the constituent proportions must remain unchanged during production.  **Blast Furnace Slag**  * + 1. Products comprising blast furnace slag or blends of quarried material and blast furnace slag shall compy with the designated quality requirements for quarried Class 1, 2 or 3 pavement materials detailed in Attachment R15A.     2. Blast furnace slag shall meet the requirements of the SA EPA Waste Derived Fill (Blast Furnace Slag) Specification 2015.     3. The Supplier must provide the Principal with a written statement of compliance certifying that the Blast Furnace slag complies with the chemical criteria of the SA EPA Waste Derived Fill (Blast Furnace Slag) Specification 2015.  **Alternative Sources of Recycled Materials**  * + 1. If the Contractor proposes to supply reclaimed or industrial materials and by-products other than those described above in this Part, it must undertake a comprehensive environmental assessment of the proposed material to determine contaminant levels.     2. The assessment must be consistent with Department of Planning, Transport and Infrastructure Environmental Instruction 21.6 “Recycled Fill Materials for Transport Infrastructure” (available from http://www.dpti.sa.gov.au/standards/environment) and in particular the requirements of Clause 11 “Use of Material or Soil from Non-DPTI Sources” of the Instruction. Products from Alternative Sources must not be supplied without project specific written approval from DPTI.     3. The Products must comply with the designated quality requirements for each recycled product detailed in Attachment R15A.     4. Suppliers of reclaimed or industrial materials and by-products must maintain quality control procedures to ensure adequate detection and management of contaminants, including procedures relating to storage and handling, processing, sampling, analysis and reporting.     5. The assessment of the materials must be appropriate to the physical and chemical nature of the material and its intended use. The quality control procedures must be endorsed by an appropriately qualified professional with at least 7 years experience in site contamination management.  PERFORMANCE BASED PAVEMENT MATERIALS  * + 1. This Clause specifies the requirements for Performance Based Materials, which are designed and manufactured to meet particular levels of in-service pavement performance. Performance Based Materials may only be used where permitted in **Contract Specific Requirements** **“Pavement Work”.**     2. Where a Contractor proposes to design a pavement material to meet pavement performance criteria, the following must apply:        - 1. The Contractor must determine the Mix Design properties for the product based on the full suite of tests identified in the Mix Design Limits of the product specification. With the exception of Resilient Modulus/Deformation testing and Triaxial Compression testing, results from testing a minimum of ten samples of product must be used to determine the average test value. This value will be the nominated Mix Design value for that test property or sieve size. Each sample must be representative of a minimum of 100 tonnes of product.          2. Mix Designs must comply with the limits specified in "Mix Design Limits" of each product specification.          3. The Contractor must submit a reference sample of the product.          4. Resilient Modulus/Deformation testing and Triaxial Compression testing must be performed in duplicate on a sample representative of the submitted mix design and reference sample.          5. The Contractor may be requested to submit further evidence of conformance to Resilient Modulus and Triaxial Compression requirements on samples representative of the extremes of the permissible grading envelope for manufacturing, and/or field trial evidence of acceptable performance where the mix design is closer than one standard deviation from the Mix Design Limit for any specified sieve size.     3. The Contractor must submit supporting mix design and/or specification conformance documentation including results for the full suite of tests identified in the Mix Design limits of the product specification. Subject to the product meeting all requirements of the Specification, DPTI will register the mix design and apply the Manufacturing Tolerance to the Mix Design for Product Quality Control purposes.     4. The Contractor must not supply material under a Mix Design specification until written approval and the manufacturing tolerances have been received. Approval will remain current for a period not exceeding 2 years. The approval may be withdrawn in the event of unsatisfactory field performance of the material, or if the reference sample is no longer representative of delivered material.  STABILISED AND WET-MIXED MATERIALS (Plant Mixed)**General**  * + 1. Stabilised materials (which includes the addition of cement, fly ash, lime, bitumen, other binders or combinations of binders) and wet-mixed materials must comply with this clause 8.     2. Stabilised materials are specified by class of pavement material, and by either binder content or strength. Materials specified by binder content basis must be tested for binder content in accordance with Clause 8 under "Additive Content Determination".     3. Materials specified on a strength basis must be tested for Unconfined Compressive Strength in accordance with Clause 8 under "Strength Determination Testing".     4. The addition of cement, flyash, bitumen, lime, or slag and water must be described by a suffix system as given in the following examples:  |  |  | | --- | --- | | SPM2/20QGC4 | 20 mm Class 2, 4% Cement Stabilised Quarried Pavement Material; | | SPM1/30RMC4MPa | 30 mm Class 1, 4 MPa Cement Stabilised Recycled Pavement Material; | | SPM2/40QGB3 | 40 mm Class 2, 3% Bitumen Stabilised Quarried Pavement Material; | | SPM2/20QGL1F2 | 20 mm Class 2 Stabilised Quarried Pavement Material with 1% Lime, and 2% Flyash; | | SPM2/30QGL1S4 | 30 mm Class 2 Stabilised Quarried Pavement Material with 1% Lime and 4% Slag. |  * + 1. Wet-mixed material is a mixture of Class 1, 2 or 3 Pavement Material and water, produced at a central mixing plant to a controlled moisture content that is based on the modified optimum moisture content of the material. Wet-mixed materials are identified by the suffix “W” as illustrated in the following examples:  |  |  | | --- | --- | | PM1/20QGW | 20 mm Class 1 Quarried Pavement Material Wet-Mix (Grading Based) | | PM1/20RMW | 20 mm Class 1 Recycled Pavement Material Wet-Mix (Performance Based) |  **Recycled Products**  * + 1. Cement, fly ash, lime, slag, bitumen or other binders must not be added to recycled pavement material products without prior approval.     2. Where a Contractor proposes to produce a stabilised recycled product, the following must apply:        - 1. The Contractor must submit evidence of compliance of the product to the full suite of tests detailed in the Product Specification Sheets (Attachment R15A) for Stabilised Pavement Material.          2. The Contractor must submit a reference sample of the untreated recycled material, which must be representative of a minimum of ten samples of product, and a sample of the proposed binder.          3. The Contractor must undertake Unconfined Compressive Strength testing on three pairs of specimens at each binder content and curing age detailed in the Product Specification. Samples prepared for testing must be representative of the reference sample.  **Strength Based Stabilised Material**  * + 1. Where the use of a stabilised material meeting strength based acceptance criteria is permitted under this Contract, the following applies prior to commencement of supply:        - 1. The Contractor must submit evidence of compliance of the product to the full suite of tests detailed in the Product Specification Sheets (Attachment R15A) for Stabilised Pavement Material (Strength Control).          2. The Contractor must submit a reference sample of the unstabilised material, which must be representative of a minimum of 10 samples of product, and a sample of the proposed binder.          3. The Contractor must undertake Unconfined Compressive Strength testing on 3 pairs of specimens at the binder contents and curing age required to meet the full range of strength targets detailed in the Product Specification. Samples prepared for testing must be representative of the reference sample.     2. Strength based stabilised material must not be supplied without prior approval.  **Binders**  * + 1. Binders and Additives must comply with Table 8.10 "Binder Properties".  |  |  | | --- | --- | | **TABLE 8.10 BINDER PROPERTIES** | | | Bitumen | Class 170 residual bitumen to DPTI Master Specification, Part R25 "Supply of Bituminous Materials" or other approved special foam binder | | Cement | Blended cement complying with AS 3972 "Portland and Blended Cements". | | Lime | Hydrated lime or quick lime complying with AS 1672 "Building Limes". Quick lime must be fully slaked | | Fly ash | Fine, medium or coarse fly ash meeting the requirements of AS 3582 "Supplementary Cementitious Materials for use with Portland Cement – Part 1 Fly Ash". | | Slag | Ground granulated blast furnace slag must meet the requirements of AS 3582 "Supplementary Cementitious Materials for use with Portland Cement – Part 2 Ground Granulated Blast Furnace Slag” | | Chemicals | Proprietary chemical binders may be used provided documented evidence as to their suitability is submitted. Procedures for the use, dosage and handling of the binder must be included in the Contractor’s Quality Plan. | | Water | Water must be potable |    **Additive Content Determination** Bitumen   * + 1. The bitumen content of the treated material must be as ordered, expressed as a target percentage of dry mass. The bitumen content may vary up to ± 0.25% from that ordered. The bitumen content must be determined in accordance with AS/NZS 2891.3.3 “Binder Content and Aggregate Grading – Pressure Filter Method”.   Powder Form Binders   * + 1. The binder content of the treated material must be as ordered, expressed as a target percentage of dry mass. The binder content may vary up to ± 0.5% from that ordered. The Contractor must identify in the Quality Plan a methodology for control, measurement and quality assurance of the specified binder content. Proposed procedures must be subject to approval prior to the supply of material.   Liquid Binders   * + 1. Liquid binders must be ordered as a minimum percentage of the dry mass of untreated product or by loose volume of untreated product. The Contractor must identify in the Quality Plan a methodology for control and quality assurance of the binder content.   Combination Binders   * + 1. Combination binders must be ordered as a minimum percentage of the dry mass of untreated product or by loose volume of untreated product. The Contractor must identify in the Quality Plan a methodology for control and quality assurance of the respective binder contents.   Water   * + 1. The moisture content of bitumen, cement, lime and/or fly ash treated material when combined with water and water by itself ordered as a wet mixed product must be ordered expressed as a percentage of dry mass. The moisture content may vary up to ± 1.0% from that ordered.   Test Frequency   * + 1. The Contractor must include in the Quality Plan procedures for verifying the additive content for each 150 tonnes of treated material.  **Strength Determination Testing** Powder Form Binders, Liquid Binders and Combination Binders   * + 1. The strength of the treated material must be as ordered, expressed as a target Unconfined Compressive Strength in MPa. The average strength of the test cylinders for each test may vary up to - 0.5 MPa, + 1.0 MPa from that ordered. Strength must be determined in accordance with AS 1141.51 "Unconfined Compressive Strength of Compacted Bound Materials".     2. A contingency representative sample of the untreated material used in the production of plant treated material must be taken from each day’s production.   Test Frequency   * + 1. Samples of stabilised materials must be tested for strength at a rate not less than 2 tests (4 test cylinders) per 150 tonnes. Where Contractor developed procedures are proposed, the Contractor must include in the Quality Plan procedures for verifying the additive content for each 150 tonnes of treated material.  **Addition of Retarder**  * + 1. A retarder must be used with blended cement binders. The proposed retarder and usage rate must be nominated in the Contractor’s Quality Plan. The Contractor‘s mixing plant must be fitted with a measuring device to allow accurate measurement of the amount of retarder being added to the mix.  **Mixing**  * + 1. The quarry material, selected additive (if specified) and/or water must be mixed at a central mixing plant of the pugmill type. The mixing plant may be either a batch or continuous type. The mass of charge in a batch mixer or the rate of feed to a continuous type mixer must not exceed that which will permit complete mixing of all material.     2. Mixing of material must be continued until the quarry material, binder, retarder and/or water are evenly distributed through the mass and a uniform mixture of unchanging appearance is obtained. Sufficient mixing capacity must be provided to produce enough mixture to permit placing up to 200 tonne of mixture on the road bed per hour.  **Transporting**  * + 1. During transportation, the load must be completely covered with a tarpaulin or similar heavy cover to protect the material against the effect of sun and rain. The cover must not be removed until the load is about to be tipped.  **Time Requirements**  * + 1. Cement treated material must be delivered to the road bed or construction site within a time sufficient to enable all spreading, shaping and compaction to be carried out within 2.75 hours of the introduction of cement to the untreated material.     2. Blends of lime and fly ash or lime treated material must be delivered to the road bed or construction site on the same day as the introduction of lime and/or fly ash to the moist material. Bitumen treated material may be stockpiled for a period not exceeding 4 weeks.     3. Wet mix material must be delivered to the road bed or construction site and placed/compacted in a time that ensures that the moisture content of the material remains within the specified tolerance of that at which it was ordered. Other binders must be delivered to the site within time periods detailed in the Contractor's Quality Plan.     4. The time of binder addition must be recorded on the cart-note for each load of stabilised material.  RAIL BALLAST  * + 1. The production of rail ballast must comply with this clause 9.     2. The Contractor must undertake petrographic analyses of the source rock to the extent that all mineralogical variations of the rock are examined.     3. Where basic igneous source rock is used for the production of ballast, the Contractor must indicate in the Quality Plan the maximum acceptable level of secondary mineralisation of the source rock and procedures for monitoring the product during quarrying and production.     4. Notwithstanding that the rock may comply with other requirements of this specification, ballast must not contain minerals in a concentration that may be detrimental to the overall performance of the ballast in service.     5. The ballast shall be managed at all stages to prevent material contamination, segregation and degradation. Unnecessary handling shall be avoided at all times, such as repeated mechanical handling and dropping of material.     6. Where the ballast is to be used under steel sleepers, the ballast must comply with Classification RAIL60S.  ASPHALT AGGREGATES AND SAND  * + 1. The production of asphalt aggregates and sand must comply with this clause 10.     2. The production process must provide material to meet the grading requirements for the appropriate aggregate size to produce a particular asphalt type.     3. Once the Design has been completed, the grading of the aggregate to be supplied must be known as the "Nominated Grading". Production tolerances for the assessment of conformity to the design must comply with Attachment R15A.     4. The associated properties of each aggregate type complying with the property limits as shown in Attachment R15A must be determined and thereafter be referred to as the Nominated Property; for example, "LA Nominated Property".     5. PAFV assessment of any size product from a particular source must be undertaken on aggregates within the -9.5 mm to +6.7 mm size fraction of the same product source in accordance with AS 1141.40 Section 7.1.  HOLD POINTS  * + 1. The following is a summary of Hold Points referenced in this Part:  |  |  |  | | --- | --- | --- | | **CLAUSE REF.** | **HOLD POINT** | **RESPONSE TIME** | | 2 | Submission of Procedures (where the Principal does not hold a copy of the current procedures) | 7 days | | 6 | Proposal to use Recycled Material or Blast Furnace Slag in lieu of Quarried Material. | 14 days |  VERIFICATION REQUIREMENTS AND RECORDS  * + 1. The Contractor must supply written verification that the testing undertaken demonstrates compliance with the requirements of this Part and supply the verification with the lot package.   \_\_\_\_\_\_\_\_\_\_\_\_ | **1. GENERAL**  Context  It is the intention that the Specification provides a reasonable opportunity for different material types to be available for use, whilst setting a minimum standard of quality.  Prequalification  Commercial quarries and mobile crushing Contractors supplying products or services to the Department are required to be Prequalified.  Prequalified quarries and mobile crushing companies are listed on the Companies Register, available on the DPTI website (http://www.dpti.sa.gov.au/contractor\_documents/prequalification). This document indicates the companies and quarries that have demonstrated a minimum level of capability to supply specific pavement materials and/or mobile crushing services to the Department. Each quarry is prequalified for specific products, as listed in the Register.  This Specification applies for materials supplied by quarries, mobile crushing companies under Contract to the Department, or third party suppliers. There are no special requirements in this Specification based on the type of supplier.  **2. QUALITY REQUIREMENTS**  **Quality Plan, Procedures and Documentation**  All Materials  Quarry materials are liable to segregate during all stages of the crushing and screening process. Flow of material off conveyor belts, or onto conical stockpiles together with the action of wind and gravity, can separate finer material from coarser material. During crushing, the feed rate into a crusher can influence the degree of crushing and shaping of particles; feed rate to screening plant can influence the efficiency of the screening process due to flooding of the screens. Random selection of sample increments removes any tendency for bias in their selection. Similarly, incorrect sample splitting can produce sub samples that are not the same and may result in test results being unrepresentative of the Lot from which they came.  Effort expended in producing a conforming product can be rapidly undone through cross contamination with other materials and may have serious consequences on the efficiency and conformance of downstream manufacturing or road building processes.  Material sourced from Quarries  Correct calibration, maintenance and adjustment of crushers, screen decks, flow meters etc. is essential for the production of consistent and conforming product. Holes in screen decks can lead to inclusion of oversize particles. Changes in crusher settings can lead to particle size distribution moving outside specification.  Assessment of the quarry face and shot rock may identify excessive weathered material or change in rock properties prior to processing through the crushing plant. Particular faces of the quarry may be better suited to crushed rock production or to aggregate production.  Labelling storage bays and silos assists in minimising the risk of cross contamination with other products.  Sealing Aggregate  Adhesion of sealing aggregate to binder is a function of the rock chemistry and is independent of the crushing and screening processes (notwithstanding the cleanliness of the product due to dust coatings etc.).  [See also: Clause 4 under “Aggregate Stripping”; Clause 5 under “Testing”; Part R15 Attachment A.]  Basic Igneous Source Rock  Basic igneous rocks may contain deleterious secondary minerals, e.g. in particular lava flows or alteration zones within the quarry deposit. These minerals can result in rapid disintegration of crushed aggregates in stockpile or in service. Procedures that enable the identification of such minerals allow the quarry to manage the rock resource appropriately to ensure products meet specification requirements.  ‘A major consideration is that the mineralogy of basalts can be meta-stable; the stone may be hard and competent at the time of quarrying but prone to breakdown in the medium term (months/years) due to the presence of what are referred to as secondary minerals which can occur due to a variety of alteration processes at a late stage in the formation/cooling of the rock.’ [1]  Secondary mineralisation can be detected using a combination of petrographic thin sections, unsound and marginal stone content testing and X-Ray diffraction and can be minimised through double screening.  Further information on Secondary Mineralisation is available in Austroads Guide to Pavement Technology Part 4J: Aggregate and Source Rock [11]. [See also: Clause 4 under “Secondary Mineralisation”; Clause 5 under “Testing”; Part R15 Attachment A.]  Recycled Materials (Construction and Demolition Materials)  Theproperties of crushed recycled materials are dependent on the properties of the source materials. Variability in the properties of each component material, e.g. crushed concrete, brick, tile or asphalt as well as variability in the proportion of each component in blended products can affect conformance with specified properties as well as long term durability in service. Procedures for managing the quality of constituent materials and for managing blend proportions are important for achieving consistent quality of recycled products.  [See also: Clause 6: “Recycled Materials and Blast Furnace Slag”.]  Stabilised Materials  The performance of stabilised materials in service is reliant upon achieving the long term strength requirements expected by the pavement designer. Stabilised materials must have the required binder/additive content to achieve design strength targets and must remain workable for the time required to deliver, spread and compact the material in the roadbed. Procedures for controlling binder contents, retarder addition and assessment of allowable working time are essential for achieving intended in service performance.  [See also: Clause 8 “Stabilised and Wet-Mixed Materials (Plant Mixed)”.]  **Asphalt Aggregates**  Asphalt is a high value product. The manufacture of asphalt involves blending of coarse and fine aggregates, fillers and binder in consistent proportions. The key to achieving consistent and conforming asphalt is having raw materials that are produced to consistent quality standards. [See also: Clause 10 “Asphalt Aggregates and Sand”.]  **Identification**  The specified Lot sizes are based on several considerations:   * The daily production from a typical crushing plant * The value of the product as a road building material * The importance of consistent quality of raw materials used in the manufacture of concrete or asphalt * The consequences of a failure attributable to non-conforming material quality * Cost of compliance testing   Quarries that meet prequalification requirements and can demonstrate a consistent conformance history for the product are eligible to apply for a reduced frequency of testing (Refer Clause 5 under “Reduced Rate of Testing”).  **Dedicated stockpiles**  These criteria are to ensure that all material in a stockpile is conforming. The clause allows multiple Lot stockpiles to be created thereby potentially minimising transport and handling costs providing that each Lot within the stockpile is accessible until conformance to specification has been confirmed. Construction of the stockpile in layers assists in achieving a more uniform blend of material for construction purposes. Loading from a multi-layer stockpile results in cross mixing of material from different Lots thereby achieving a more consistent supply of product to the roadbed. This in turns assists with achieving uniform placement and compaction outcomes at the construction site. The maximum height of a dedicated stockpile should be limited to approximately 4 metres.  **Aggregate Stripping (TP 705)**  The adhesion properties of an aggregate to a bituminous binder can be improved through the use of precoating and adhesion agents. The design process is required to determine the most appropriate type and quantity of precoat, the proportion of adhesion agent in the precoat and whether or not an adhesion agent is required in the binder, in order to meet specification requirements.  [See also: Clause 5 under “Testing”]  **Secondary Mineralisation**  VicRoads is the only known provider of the service to establish rock type and durability classifications.  [See also: Clause 2 under “Quality Plan, Procedures and Documentation”; Part R15 Attachment A.]  **5. SAMPLING AND TESTING**  **Testing**  General  The minimum test frequency in Table 5.7 “Quality Assurance Minimum Testing Frequencies” is intended to be a balance between an acceptable cost and an acceptable level of confidence in the performance of the material [2].  Pavement materials tests have their limitations, and it is important to understand these when selecting pavement materials. Limitations can potentially result from the test method in combination with the source material properties or from sample collection and operator techniques. Some of these limitations are described in this Section.  Particle Size Distribution  The specified limits envelope for the Particle Size Distribution (PSD, or ‘grading’) curve for a road base product is derived from Fuller’s maximum density curve [7], using the following equation:  P = (d/D)n x 100  Where P = percentage passing sieve size d  d = nominal sieve size (mm)  D = nominal maximum particle size (mm)  n = the exponent (n = 0.5 for maximum density)  For most crushed rocks, the value of n varies between 0.3 and 0.45 [7]. Further discussion can be found in the Austroads Guide to Pavement Technology Part 4A: Granular Base and Sub-base Materials [7].  Los Angeles (LA) Abrasion  Some potential limitations with the LA Abrasion test are as follows [1]:   * The breakdown is assessed in relation to the 1.8 mm sieve which is an arbitrary criteria. If the material breaks down to a size marginally larger than the 1.8 mm sieve, the breakdown is not recognised in the testing. * The LA value for any sample is an average of the hardness levels of the individual particles. * The LA value is a ‘measure primarily of the impact/crush resistance of the rock and may not have a direct relationship with any compressive strength value for the mass rock and only limited correlation to the mineralogical hardness (Moh’s Scale) of the component minerals.’   Wet / Dry Strength Variation  Also known as the 10% Fines test, this test is a durability measure that involves the compressive crushing of a sample of aggregate contained in a steel cylinder and adjusting the applied load to produce 10% of arbitrarily defined fines. The test is undertaken on aggregates in both a wet and dry condition. A high wet/dry variation normally correlates to poor soundness properties. (Refer Austroads Guide to Pavement Technology: Part 4J Aggregate and Source Rock [11].)  Resilient Modulus / Deformation  The South Australian test method is based on Australian Standard AS1289.6.8.1 and involves the application of 50,000 load repetitions at a single stress condition. Test specimens are statically compacted by hydraulic ram in two layers to 98% MDD and 80% OMC which is intended to represent a relatively severe in service moisture condition in South Australia’s environment. The test procedure arose from research effort since 1991 that involved testing of a wide range of South Australian quarry products, and contribution to a national research effort into developing test procedures and specification criteria for performance based specifications for crushed rock products.  [See also: Clause 7 “Performance Based Pavement Materials”.]  Triaxial Compression  This test measures the shear strength properties of a 200 mm high x 100 mm diameter specimen of soil or granular roadbase material. In the test, horizontal stresses are kept constant, whilst vertical stress is increased at a fast rate to produce failure. The test provides maximum stress limits (failure limits or shear strength) that the materials can take, beyond which the stress state cannot exist in the material. The static triaxial shear test has been accepted as a standard test to determine strength for granular base materials (AS 1298-6.4.1 Standards Australia 2000). This method allows three levels of failure stress to be applied to a single test specimen.  TP 184 is a modified version of the AS method and specifies static compaction of the specimen by hydraulic ram in two layers, compaction to 98% MDD and 80% OMC, which is intended to represent a relatively severe in service moisture condition in South Australia’s environment. Confining pressures of 30, 60 and 90 kPa are applied to the specimen. From the test the Mohr’s failure envelope is determined and Cohesion and Friction Angle for the granular material reported.  [See also: Clause 7 “Performance Based Pavement Materials”.]  Unsound and Marginal Stone Content  VicRoads use Test Method RC 372.02 to prepare the reference samples.  The reference jars need to be representative of the product that is being compared against it for classification. Quarries may need to review their testing regime and be aware of the origin of the reference jars, especially when changing to a different source rock unit.  To complement Unsound and Marginal stone testing, a petrographic thin section could be considered. ‘A petrographic thin section (microscope analysis) provides a useful means of assessing the mineralogy and fabric of a rock material and from that there can be some clarification or prediction of the properties of the rock.’ [1]  Aggregate Particle Shape Tests (Flakiness Index, % Flat Particles, Mis-Shapen Particles, ALD)  ‘The shape of aggregate particles is a function of both the fabric of the rock, where it might have a propensity to break in a preferred direction or directions (e.g. schistose, fractured or fissile) and the crushing process; in the latter case, high reduction ratios for particular crusher types may cause the rock to generate splinters (i.e. flaky and elongate particles). There are types of crushers which are more appropriate for equidimensional particle production (e.g. impact crushers, vertical shaft impact crushers, low reduction setting cone crushers) although these may generate increased levels of undersized product than a jaw, gyratory or high reduction setting cone crusher.’ [1]  ALD is used to determine the aggregate spread rate and binder spread rate in sprayed seal design. In the design phase, the ALD is usually assumed to be 60% of the nominal aggregate size. Prior to binder application, the actual ALD is measured and final application rates are calculated. It is believed that three tests will give a range of values and the average of these values will give a better indication of the true ALD for that Lot. Also if one of the values of the three tests were to differ considerably from the other two this would then be an indicator of a poor result or highlight the need for further investigation.  ALD results assessed by the direct or calculated method may not produce the same result. Over the years, DPTI has put consideration into which method should be used in the spray seal design. Part R15 previously (2006) included a verification check of direct and calculated ALD measurements (see below for excerpts). Since both types of ALD values will be provided, the designer will need to judge the value adopted for the design.  Excerpt from Part R15, 2006 Edition:  *Calculation of the average least dimension of sealing aggregate shall be carried out in accordance with AS 1141.20.1 or AS 1141.20.2 “Average least dimension - Direct measurement” (ALDd), and by AS 1141.20.3 “Average least dimension - calculation (nomograph)” (ALDc).*  *The calculated ALDc shall be checked against the permissible range in Table 10.*   |  |  | | --- | --- | | *Table 10  Verification Check of ALDc* | | | *Aggregate Size* | *Permissible Range* | | *SA 16-10* | *0.56 x ALDd + 3.81 < ALDc < 0.56 x ALDd + 4.81* | | *SA 14-10* | *0.56 x ALDd + 3.81 < ALDc < 0.56 x ALDd + 4.81* | | *SA 10-7* | *0.50 x ALDd + 2.93 < ALDc < 0.50 x ALDd + 3.53* | | *SA 7-5* | *0.41 x ALDd + 2.06 < ALDc < 0.41 x ALDd + 2.66* |     *If ALDc is outside the permissible range in the table above, a new test portion from the bulk sample representing the Lot shall be produced and tested in accordance with AS 1141.20.1 or AS 1141.20.2 “Average least dimension - Direct measurement”. ALDd and ALDc shall be reported on the test certificate.  Where a repeat test is undertaken, both ALDd results and ALDc shall be reported.*  Aggregate Stripping  The aggregate stripping test measures the adhesion of bitumen to aggregate particles to assess the potential level of stripping of particles from the road surface due to the action of traffic and wet weather. ‘The test is also done with various additive stone coatings used (pre-coat) and may identify whether an additive is required and at what concentration it should be used for suitable performance of the stone. Binder additives are also used with the bitumen.’ [1]  [See also: Clause 4 under “Aggregate Stripping”; Clause 2 under “Quality Plan, Procedures and Documentation”.]  PAFV  PAFV for sealing and asphalt aggregates is tested to the vertical method. PAFV assesses the resistance of a rock material to polishing, which is a contributing factor to the skid resistance performance of the aggregate in service. More information on this test and skid resistance is presented in Harvey (2014) [1].  The vertical wheel test was derived from UK Road Research Laboratory research in the 1950s and was widely adopted across Australia. NSW developed the horizontal wheel test method in the early 1960s and adopted this technique as their standard. (Refer Austroads AP-T177-11).  Australian Standard test methods have been prepared for both procedures and both are well proven. DPTI has not undertaken a formal correlation study of the two methods and no other correlation studies have been located. DPTI’s historical records for PAFV testing of South Australian aggregates are based on the vertical wheel method and specification limits are based upon this history. Until such time as a formal correlation study is undertaken and a valid correlation proven, PAFV results should only be accepted from the Vertical Wheel method (AS1141.40 / AS1141.42). This is particularly important for aggregate sources that are close to specification limits or which are known to have poor in service performance.  The skid resistance on open graded (OG) and Stone Mastic Asphalt (SMA) is largely dependent on the microtexture and hardness of the coarse aggregate used. This, and the discovery that seasonal variations cause these mixes to reduce their gripping properties in the summer months, highlighted the need to specify aggregate with the higher PAFV (Polished Aggregate Friction Value) of 55 (minimum) for sites requiring high skid resistance.  More background information can be found in knet file #2671368 – DPTI internal document only. Also, refer to the conference paper saved in knet file #8931265 “Seasonal Variation of Skid Resistance in South Australia”. A more comprehensive paper with actual quarry names for both asphalt and spray seal is saved in knet #37570552 (strictly DPTI internal document only).  DPTI Monitoring of PAFV and Aggregate Stripping  DPTI undertakes its own monitoring of PAFV and aggregate stripping annually. DPTI collects samples from sources that may be used in the following spray seal season. The purpose of this monitoring is for DPTI’s own use and that smaller quarries are not burdened disproportionately by the requirement for this testing. DPTI remains the owner of the information and will not provide laboratory test certificates. A certificate will be required for the above mentioned tests by the contractor for material supplied on DPTI works.  Atterberg Limits  These limits are based on the concept that a fine grained cohesive soil can exist in four states depending on its water content; i.e. solid, semi-solid, plastic and liquid. The greater the amount of water a soil contains, the less interaction there will be between adjacent particles and the more the soil will act like a liquid. The water contents at the boundaries between adjacent states are termed the shrinkage, plastic and liquid limits respectively.  For pavement materials, a high plastic limit may indicate the presence of an undesirable amount or type of clay.  The liquid limit of a soil increases with an increase in the amount of flaky (eg clay, mica), fibrous or organic particles present. It therefore gives a useful warning of the presence of undesirable components leading to poor stability of a compacted granular layer.  The plasticity index gives a measure of the cohesive properties of the binder resulting from the clay content and gives an indication of the amount of swelling and shrinkage that will result from wetting and drying of the fines. A deficiency of clay binder, (eg a non-plastic crushed rock), may cause ravelling of a gravel wearing course during dry weather and excessive permeability. Conversely, An excess of clay results in loss of stability of the gravel when wet.  Linear shrinkage is the percentage decrease in dimension of the fine fraction of a soil when it is dried after having been moulded in a wet condition. It is useful for soils and granular pavement materials with low clay contents on which the liquid and plastic limits, and hence plasticity index are often difficult to measure. The plasticity index numerically is approximately 2.5 times the linear shrinkage percentage.  Further information can be found in Austroads Guide to Pavement Technology Part 4A: Granular Base and Sub-Base Material [7].    **Reduced Rate of Testing**  Prior to 2015, reduced testing was only available on a contract basis. Quarries are now able to apply for a ‘blanket’ reduced testing across contracts. The reduced frequency of testing provisions apply to tests that are related to the properties of the source material rather than to tests related to quality of crushing and processing.  Quarries approved for a reduced rate of testing are listed on the Prequalification Register, available from the following web-link: http://www.dpti.sa.gov.au/contractor\_documents/prequalification  **6. RECYCLED MATERIALS and blast furnace slag**  **Construction and Demolition Materials**  Crushed concrete has similar properties to crushed rock in terms of its behaviour and durability in an unbound granular material. The proportion of supplementary materials is limited to 20% in these specifications because materials such as brick and tile are clay based products. Their properties are dependent on the degree of kiln firing during the manufacturing process. They are also softer and crush down to fines during the crushing process and contribute some plasticity to the blended product. Whilst a proportion of fines and plasticity are both desirable in a crushed rock, an excessive proportion will result in loss of strength or durability in service.  Use of asphalt in a granular basecourse material is a relatively low value application for a valuable resource. In very high proportions (>50% asphalt) a recycled blend can be sensitive to compaction moisture and more difficult to compact.  **Blast Furnace Slag**  Types of slag can be categorised as follows:   * Slag derived from iron making processes:   + Blast furnace (BF) slag   + Granulated blast furnace (GBF) slag   + Ground granulated blast furnace (GGBF) slag * Slag derived from steel making processes:   + Basic oxygen steel (BOS) slag   + Electric arc furnace (EAF) slag   This Specification for Blast Furnace slag does not apply to granulated blast furnace slag or ground granulated blast furnace slag.  Dense blast furnace slag typically has poor polishing characteristics and is not suitable for surfacing aggregates. Scoriaceous slag may be suitable if particle strength is adequate.  The NSW state road authority (RMS) has experience with the use of slag as road products. NSW has experienced expansive reactions arising from the use of steel slag, particularly oxygen slag in sub-base layers, and this material is not accepted under this Specification. There is no current SA EPA specification for slag derived from steel making processes.  [See also: Clause 2 under “Quality, Plans, Procedures and Documentation”.]  **Alternative Sources of Recycled Materials**  The utilisation of recycled (construction and demolition) materials and industrial by-products is a community expectation related to environmental sustainability and reduction in waste management costs. This clause is intended to provide an opportunity for alternative resource materials to be considered for recycling as granular pavement materials subject to meeting broader environmental objectives.  **7. PERFORMANCE BASED PAVEMENT MATERIALS**  It had been observed in South Australia that many *non-*s*tandard* materials (ie those that did not meet the conventional classification criteria for grading, hardness and Atterberg Values) performed adequately in pavements. The research project was initiated to establish an alternative testing procedure for assessment of roadbase performance which could suitably categorise these types of materials.  The research project commenced in 1991 with the objectives of:   * Characterising the elastic and plastic responses of crushed rock products at varying density and moisture content with a view to application in mechanistic pavement design * To provide data for development of performance related material specifications.   As a result of the work which occurred over several years, mechanistic material properties of a wide range of South Australian quarry products had been measured, and their sensitivity to compaction density and moisture content assessed. Arising from this testing, performance based criteria comprising Los Angeles Abrasion, Resilient Modulus, Permanent Deformation and Permanent Strain Rate were recommended for inclusion in a performance based specification in 1997.  South Australia was also key member of an Austroads Working Group researching performance based specification criteria and developing a test method for the characterisation of performance based material properties. The test method was developed in response to a need for performance characterisation indices and performance-based specifications for unbound materials to address a range of emerging issues including:   * The utilisation of recycled (construction and demolition) materials and industrial by-products to meet community expectations related to environmental sustainability and reduction in waste management costs. * The most efficient use of increasingly scarce high quality materials. There is a need for ‘fit for purpose’ materials so that the highest quality materials are only used where they are needed. * The increase in heavy vehicle loading (increasing axle number, gross mass and tyre pressure) and the introduction of new generation vehicles which are placing higher stresses on granular materials.   During this time an Australian Standard test Procedure was developed (AS1289.6.8.1) for repeat load triaxial testing of pavement materials. The Austroads Working Group worked on developing a test procedure based on the AS method to characterise the performance of granular pavement materials. The procedure was published as the output of Austroads Projects N&T 9529 during 1999/2000. The procedure covers the determination of both the permanent deformation and resilient modulus of unbound granular materials using repeated load triaxial equipment incorporating static confining pressures and external vertical displacement measuring devices, under drained conditions, without pore pressure measurement. Whilst the Austroads method involves the application of three stress conditions each loaded 10,000 times, South Australia developed a simplified method involving 50,000 load repetitions at a single stress condition.  (*Refer Materials Technology Research and Development Program MTRD Report No MT 16-10 Performance Comparisons of Granular Basecourse Materials using Repeated Load Triaxial Testing April 1997 – DPTI Internal Report; Austroads AP-R360-10 [16] and AP-T29-03 [17]).*  Where pavement materials do not meet the traditional ‘recipe-based’ (grading based) specifications, the performance based system is an alternative option for Class 1 and 2 recycled and quarried pavement materials.  In comparison to grading based specifications, the supplier can nominate a grading outside the traditional specifications, with a slight increase permitted for plasticity limits of Class 2 products and no limit placed on Los Angeles Abrasion. The broader limits of these properties are supplemented by requirements to meet relatively tight production tolerances along with certain performance criteria assessed by static triaxial and repeated load triaxial testing. [2]  RLT and Static Triaxial testing must be carried out to the DPTI methods TP183 and TP184 respectively (as specified in Part R15) as these are the test methods that the Part R15 specification limits were developed for.  Quarries are responsible for engaging a laboratory to undertake the performance testing. There are limited laboratories in Australia that are available to undertake the Resilient Modulus/Deformation testing. For a list of laboratories that are able to provide the testing, please contact the Pavement Materials Engineer, DPTI, on 8343 2628. Results of performance testing, along with results of a minimum of ten samples of recent/representative material, are submitted to DPTI, and DPTI uses this information to prepare a mix design certificate.  Clause (e) was added in 2005 when manufacturing tolerances were widened, at the request of industry. Due to the widening of the manufacturing tolerances, there is greater potential for product at the extremes of the tolerance to exhibit poor performance (DPTI reference knet #855618 - DPTI internal document only).  The manufacturing tolerances for performance based materials ‘were derived from statistical assessment of data from a number of Transport SA (DPTI) managed crushing contracts’ [2]. ‘The tolerance represents nominally twice the standard deviation of results from these contracts. Accordingly, a well-controlled crushing operation should be within specification 95% of the time.’  Details describing the widening of manufacturing tolerances in 2005 are described in the document knet #855618 (DPTI internal document only).  [See also: Clause 5 under “Testing”]  **8. STABILISED AND WET-MIXED MATERIALS (Plant Mixed)**  **General**  Background information on stabilised materials, including binders, is available in the Austroads Guide to Pavement Technology, Part 4D, “Stabilised Materials”. Further information is also published through the Pavement Recycling and Stabilisation Association (AustStab, see http://www.auststab.com.au/).  [See also: Clause 2 under: “Quality Plan, Procedures and Documentation”]  **Recycled Products**  Because of the range and potential variability of source materials that may be used in recycled products, the compatibility of the binder with the recycled material needs to be assessed. Bound pavement subbase layers are usually the “critical” layer in pavement design models and their long term performance controls the structural life of the pavement. Additional assurance is required that the stabilised product will consistently achieve strength and performance targets.  **Strength Based Stabilised Material**  This clause is a performance based alternative to a recipe based specification in which a particular binder content is nominated. By specifying strength as the performance measure, the supplier has greater freedom to choose the binder type and / or binder content to achieve the target strength. Bound pavement subbase layers are usually the “critical” layer in pavement design models and their long term performance controls the structural life of the pavement. Additional assurance is required that strength targets will be achieved consistently by the product.  **Binders**  There is a range of proprietary stabilisation products available on the market. For the purposes of this clause, these may be considered as “Chemicals” and documented evidence as to their suitability is required to be submitted.  **Additive Content Determination**  The binder may be the most expensive component of a stabilised material and close control of binder content is important from a cost perspective. In addition, there may be sound technical reasons for requiring that binder contents are neither too high nor too low. The pavement designer’s objectives may be to produce a “modified”, “lightly bound” or “heavily bound” material and to design the pavement on the basis of achieving a specific maximum or minimum target strength. The pavement designer may require mix design procedures to be undertaken to not only determine the optimum binder content to achieve target material properties, but also to consider the sensitivity of the stabilised material to higher or lower binder contents.  **Mixing**  After mixing, the stabilised material should be discharged directly into a timed discharge hopper or storage bin. Discharge directly from a conveyor into a truck body or onto the ground may cause segregation of the mix. Discharge onto the ground may also result in a proportion of the stabilised material remaining on the ground beyond its working time and fail to achieve target strength requirements when subsequently placed and compacted in the roadbed.  **Time Requirements**  The working time of a binder is the time available to transport, spread and compact a stabilised material that allows the material to achieve long term strength targets. Cement treated material has a relatively short working time and failure to compact the material to the required degree within the specified time will result in a significant reduction in the strength of the stabilised pavement layer. Lime flyash, lime slag and bitumen treated blends have longer working times and are preferred for projects where time constraints are less critical or where longer haulage distances are involved.  **9. RAIL BALLAST**  AS 2758.7 defines rail ballast as a free-draining coarse aggregate used as support for railway track.  [See also: Part R15 Attachment A]  **10. ASPHALT AGGREGATES AND SAND**  Asphalt is required to meet separate target grading requirements. Blending of coarse and fine aggregates, sand and filler in controlled proportions can be designed to achieve the required asphalt target grading. For this to be achieved, the component materials (aggregate, sand and filler) must each have a consistent grading i.e. the “Nominated Grading” and be produced within the required tolerances.  [See also: Clause 2 under “Asphalt Aggregates”.] |

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| **ATTACHMENT R15A**    **PAVEMENT MATERIAL SPECIFICATION**  **LIST OF PRODUCTS**   | **Identification No.** | **Source** | **Mix Design** | **Product** | | --- | --- | --- | --- | | **SPALLS** | | | | | SP300 | Quarry | No | 300 mm Spalls | | **ROAD BALLAST** | | | | | RB100 | Quarry | No | 100 mm Road Ballast | | RB65 | Quarry | No | 65 mm Road Ballast | | **RAIL BALLAST** | | | | | RAIL50 | Quarry | No | 50 mm Rail Ballast | | RAIL60 | Quarry | No | 60 mm Rail Ballast | | RAIL60S | Quarry | No | 60 mm Rail Ballast (steel sleepers) | | **CLASS 3 RECYCLED PAVEMENT MATERIALS** | | | | | PM3/20RG | Recycled | No | 20 mm Class 3 Recycled Pavement Material [Grading Based] | | PM3/40RG | Recycled | No | 40 mm Class 3 Recycled Pavement Material [Grading Based] | | PM3/55RG | Recycled | No | 55 mm Class 3 Recycled Pavement Material [Grading Based] | | PM3/75RG | Recycled | No | 75 mm Class 3 Recycled Pavement Material [Grading Based] | | **CLASS 3 QUARRIED PAVEMENT MATERIALS** | | | | | PM3/20QG | Quarry | No | 20 mm Class 3 Quarried Pavement Material [Grading Based] | | PM3/40QG | Quarry | No | 40 mm Class 3 Quarried Pavement Material [Grading Based] | | PM3/55QG | Quarry | No | 55 mm Class 3 Quarried Pavement Material [Grading Based] | | PM3/75QG | Quarry | No | 75 mm Class 3 Quarried Pavement Material [Grading Based] | | **CLASS 2 RECYCLED PAVEMENT MATERIALS** | | | | | PM2/20RG | Recycled | No | 20 mm Class 2 Recycled Pavement Material [Grading Based] | | PM2/30RG | Recycled | No | 30 mm Class 2 Recycled Pavement Material [Grading Based] | | PM2/40RG | Recycled | No | 40 mm Class 2 Recycled Pavement Material [Grading Based] | | PM2/20RM | Recycled | Yes | 20 mm Class 2 Recycled Pavement Material [Performance Based] | | PM2/30RM | Recycled | Yes | 30 mm Class 2 Recycled Pavement Material [Performance Based] | | **CLASS 2 QUARRIED PAVEMENT MATERIALS** | | | | | PM2/20QG | Quarry | No | 20 mm Class 2 Quarried Pavement Material [Grading Based] | | PM2/30QG | Quarry | No | 30 mm Class 2 Quarried Pavement Material [Grading Based] | | PM2/40QG | Quarry | No | 40 mm Class 2 Quarried Pavement Material [Grading Based] | | PM2/20QM | Quarry | Yes | 20 mm Class 2 Quarried Pavement Material [Performance Based] | | PM2/30QM | Quarry | Yes | 30 mm Class 2 Quarried Pavement Material [Performance Based] | | **CLASS 1 RECYCLED PAVEMENT MATERIALS** | | | | | PM1/20RG | Recycled | No | 20 mm Class 1 Recycled Pavement Material [Grading Based] | | PM1/30RG | Recycled | No | 30 mm Class 1 Recycled Pavement Material [Grading Based] | | PM1/40RG | Recycled | No | 40 mm Class 1 Recycled Pavement Material [Grading Based] | | PM1/20RM | Recycled | Yes | 20 mm Class 1 Recycled Pavement Material [Performance Based] | | PM1/30RM | Recycled | Yes | 30 mm Class 1 Recycled Pavement Material [Performance Based] | | **CLASS 1 QUARRIED PAVEMENT MATERIALS** | | | | | PM1/20QG | Quarry | No | 20 mm Class 1 Quarried Pavement Material [Grading Based] | | PM1A/20QG | Quarry | No | 20 mm Class 1 Heavy Duty Quarried Pavement Material | | PM1B/20QG | Quarry | No | 20 mm Class 1 Heavy Duty Quarried Pavement Material | | PM1/30QG | Quarry | No | 30 mm Class 1 Quarried Pavement Material [Grading Based] | | PM1/40QG | Quarry | No | 40 mm Class 1 Quarried Pavement Material [Grading Based] | | PM1/20QM | Quarry | Yes | 20 mm Class 1 Quarried Pavement Material [Performance Based] | | PM1/30QM | Quarry | Yes | 30 mm Class 1 Quarried Pavement Material [Performance Based] | | **STABILISED PAVEMENT MATERIAL** | | | | | Refer clause R15.8 under “General” for examples of nomenclature for this class of pavement material. | | | | | **SEALING AGGREGATE** | | | | | SA20-14 | Quarry | No | 20/14 mm Sealing Aggregate | | SA16-10 | Quarry | No | 16/10 mm Sealing Aggregate | | SA14-10 | Quarry | No | 14/10 mm Sealing Aggregate | | SA10-7 | Quarry | No | 10/7 mm Sealing Aggregate | | SA7-5 | Quarry | No | 7/5 mm Sealing Aggregate | | SA5-2 | Quarry | No | 5/2 mm Sealing Aggregate | | **SAND** | | | | | Sa – A | Quarry/Pit | No | Type A Sand | | Sa – B | Quarry/Pit | No | Type B Sand | | Sa – C | Quarry/Pit | No | Type C Sand | | Sa – D | Quarry/Pit | No | Type D Sand | | **ASPHALT AGGREGATE**  Refer to the relevant Product Information Sheet for requirements of Source Materials and Product Quality Control. | | | | | **MINERAL FILLER FOR ASPHALT, OTHER THAN HYDRATED LIME**  Refer to the relevant Product Information Sheet for requirements of Product Quality Control.  **ADDITIONAL REQUIREMENTS FOR BASIC IGNEOUS SOURCE ROCK**  **ARRESTOR BED MATERIAL** | | | |   \_\_\_\_\_\_\_\_\_\_\_\_  **SPALLS**  **SOURCE MATERIALS**  Source materials must be natural quarried material and must be free from laminations or weak cleavages and of such character that they will not disintegrate from the action of the sea, sand or weather. No recycled material is permitted to be included.  **PRODUCT QUALITY CONTROL**   |  |  |  | | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | **QUALITY CONTROL TESTS** | | | | Particle Size Distribution  AS 1141.11 | **Product** | **300 mm Spalls**  **SP300** | | Sieve Size (mm) | Percent Passing | | 300 | 100 | | 125 | 0 – 30 | | 75 | 0 – 2 |   NOTES:   1. For all materials specifications, square aperture sieves conforming to AS 1152 "Specification for Test Sieves" shall be used for the determination of grading for particle sizes 75 mm and finer. Coarser sizes shall be determined by linear measurement.     **ROAD BALLAST**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **PRODUCT QUALITY CONTROL**   |  |  |  |  | | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | **QUALITY CONTROL TESTS** | | | | | Particle Size Distribution  AS 1141.11 | **Product** | **100 mm Ballast**  **RB-100** | **65 mm Ballast**  **RB-65** | | Sieve Size (mm) | Percent Passing | | | 125 | 100 |  | | 106 | 90 – 100 |  | | 75 |  | 100 | | 63 |  | 95 – 100 | | 53 |  | 40 – 70 | | 37.5 | 0 - 5 | 0 – 15 | | 19 |  | 0 – 2 | | AS1141.23 | LA Abrasion  Grading ‘A’ | Maximum 45% | |   NOTES:   1. For all materials specifications, square aperture sieves conforming to AS 1152 "Specification for Test Sieves" shall be used for the determination of grading for particle sizes 75 mm and finer. Coarser sizes shall be determined by linear measurement.     **RAIL BALLAST**  **SOURCE MATERIALS**  Source materials must be natural quarried material and must not include recycled material or metallurgical slag. River gravel or crushed river gravel shall not be used as railway ballast because of the poor interlock between the rounded faces of the water worn rock. All testing be undertaken on representative ballast samples and not the source rock within the quarry. The sampling procedure must ensure that the samples are representative of the materials supplied and have not been affected by segregation during handling and transport.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | | **QUALITY CONTROL TESTS** | | | | | | Particle Size Distribution  AS 1141.11 | **Product** | **RAIL50** | **RAIL60** | **RAIL60S**  **(Used under  steel sleepers)** | | Sieve Size (mm) | Percent Passing | | | | 63 |  | 100 | 100 | | 53 | 100 | 85 – 100 | 95 – 100 | | 37.5 | 70 – 100 | 20 – 65 | 35 – 70 | | 26.5 | - | 0 – 20 | 15 – 30 | | 19 | 40 – 60 | 0 – 5 | 5 – 15 | | 13.2 | - | 0 – 2 | 0 – 10 | | 9.5 | 10 - 30 | - | 0 - 1 | | 4.75 | 0 - 20 | 0 - 1 | - | | 1.18 | 0 - 10 | - | - | | 0.075 | 0 - 1 | 0 - 1 | 0 - 1 | | AS 1141.4 | Bulk Density | Minimum 1200 kg/m3 | | | | AS 1141.6.1 | Particle Density | Minimum 2500 kg/m3 | | | | AS 1141.22 | Wet/Dry Strength (2) | Minimum 150 kN Wet Strength,  Maximum 30 % Wet/Dry Strength Variation | | | | AS 1141.23 | LA Abrasion  Grading B(3,4) | Track carrying < 6 Mt (gross) per annum: Max 30%  Track carrying >6 Mt (gross) per annum: Max 25% | | | | AS 1141.14 [3] | Mis-shapen Particles % (5) | Max 30 % | | |   NOTES:   1. Refer to Clause R15.9 “Rail Ballast” for further details. 2. Samples must be prepared from an appropriately sized fraction of ballast from delivered lots. Wet/Dry Strength testing must be carried out on the fraction of material passing 26.5mm sieve and retained on 19mm sieve. 3. Los Angeles testing must be carried out on the fraction of ballast passing 19mm sieve and retained on 9.5mm sieve. 4. In accordance with AS 2758.7, the ballast itself may be crushed to provide an appropriately graded test within the size range for Los Angeles Testing only. 5. Misshapen particles must be determined on the fraction of ballast retained on the 9.5 mm test sieve using a 2:1 Calliper Ratio. The report must indicate each of % flat, elongated, and flat and elongated particles.   **CLASS 3 RECYCLED PAVEMENT MATERIAL [GRADING BASED]**  **SOURCE MATERIALS**  Source materials may be quarried material, reclaimed concrete or any combination of them. Supplementary source materials may comprise brick, tile and asphalt. Asbestos or asbestos fibre must not be incorporated into the product under any circumstances. No more than 20% by mass of supplementary materials may be incorporated and the constituent proportions must remain unchanged during production.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MANUFACTURING TOLERANCE | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | | Particle Size Distribution  TP134 | **Product** | | **20 mm Class 3**  **PM 3/20RG** | **40 mm Class 3**  **PM 3/40RG** | | **55 mm Class 3**  **PM 3/55RG** | **75 mm Class 3**  **PM 3/75RG** | | Sieve Size (mm) | | Percent Passing | | | | | | 75 | |  |  | |  | 100 | | 53 | |  | 100 | | 100 | 75 – 95 | | 37.5 | |  | 90 – 100 | | 75 – 95 |  | | 26.5 | | 100 |  | |  | 50 – 75 | | 19 | | 90 – 100 | 60 – 85 | | 50 – 75 |  | | 13.2 | |  |  | |  |  | | 4.75 | | 40 – 65 | 25 - 50 | | 20 – 45 | 20 – 40 | |  | 0.075 | | 5 – 15 | 3 - 11 | | 3 - 11 | 3 - 11 | | AS 1289.3.1.2 | Liquid Limit | | Maximum 35% | | | | | | AS 1289.3.3.1 | Plasticity Index | | Maximum 15% | | | | | | AS 1289.3.4.1 | Linear Shrinkage | | Maximum 8% | | | | | | RMS T276 | Type II Foreign Materials | | Maximum 1% | | | | | | RMS T276 | Type III Foreign materials excluding bitumen | | Maximum 0.5% | | | | | | AS/NZS 2891.3.3 | Bitumen Content | | Maximum 1% | | | | | | AS 1141.23 | LA Abrasion  Grading ‘A’ | | N/A | | Maximum 45% | | | | AS 1141.23 | LA Abrasion  Grading ‘B’ | | Max 45% | | N/A | | |     **CLASS 3 QUARRIED PAVEMENT MATERIAL [GRADING BASED]**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | | | **QUALITY CONTROL TESTS** | | | | | | | Particle Size Distribution  TP134 | **Product** | **20 mm Class 3**  **PM 3/20QG** | **40 mm Class 3**  **PM 3/40QG** | **55 mm Class 3**  **PM 3/55QG** | **75 mm Class 3**  **PM 3/75QG** | | Sieve Size (mm) | Percent Passing | | | | | 75 |  |  |  | 100 | | 53 |  | 100 | 100 | 75 – 95 | | 37.5 |  | 90 – 100 | 75 – 95 |  | | 26.5 | 100 |  |  | 50 – 75 | | 19 | 90 – 100 | 60 – 85 | 50 – 75 |  | | 13.2 |  |  |  |  | | 4.75 | 40 - 65 | 25 - 50 | 20 – 45 | 20 – 40 | |  | 0.075 | 5 - 15 | 3 - 11 | 3 - 11 | 3 - 11 | | AS 1289.3.1.2 | Liquid Limit | Maximum 35% | | | | | AS 1289.3.3.1 | Plasticity Index | Maximum 15% | | | | | AS 1289.3.4.1 | Linear Shrinkage | Maximum 8% | | | | | AS 1141.23 | LA Abrasion  Grading ‘A’ | N/A | Maximum 45% | | | | AS 1141.23 | LA Abrasion  Grading ‘B’ | Max 45% | N/A | | |   NOTE: 1. Blast furnace slag can be substituted for quarried material subject to Part R15 Clause 6.    **CLASS 2 RECYCLED PAVEMENT MATERIAL [GRADING BASED]**  **SOURCE MATERIALS**  Source materials may be quarried material, reclaimed concrete or any combination of them. Supplementary source materials may comprise brick, tile and asphalt. Asbestos or asbestos fibre must not be incorporated into the product under any circumstances. No more than 20% by mass of supplementary materials may be incorporated and the constituent proportions must remain unchanged during production.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MANUFACTURING TOLERANCE [Grading Based] | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | | | Particle Size Distribution  TP134 | | **Product** | | **20 mm Class 2**  **PM 2/20RG** | **30 mm Class 2**  **PM 2/30RG** | | **40 mm Class 2**  **PM 2/40RG** | | | Sieve Size (mm) | | Percent Passing | | | | | | 53 | |  |  | | 100 | | | 37.5 | |  | 100 | | 90 – 100 | | | 26.5 | | 100 | 90 – 100 | | 74 – 96 | | | 19 | | 90 – 100 | 77 – 95 | | 62 – 86 | | | 13.2 | | 74 – 96 |  | |  | | | 9.5 | | 61 – 85 | 51 – 75 | | 42 – 66 | | | 4.75 | | 42 – 66 | 35 – 57 | | 28 – 50 | | | 2.36 | | 28 – 50 | 24 – 44 | | 20 – 39 | | | 0.425 | | 11 – 27 | 9 – 22 | | 8 – 21 | | | 0.075 | | 4 – 14 | 4 – 12 | | 3 - 11 | | | AS 1289.3.1.2 | Liquid Limit | | Maximum 28% | | | | | | | AS 1289.3.3.1 | Plasticity Index | | Minimum 1% - Maximum 8% | | | | | | | AS 1289.3.4.1 | Linear Shrinkage | | Maximum 4% | | | | | | | AS 1141.23 | LA Abrasion Grading ‘A’ | | N.A. | | | N.A. | | Maximum 45% | | AS 1141.23 | LA Abrasion Grading ‘B’ | | Maximum 45% | | | Maximum 45% | | N.A. | | RMS T276 | | Type II Foreign Materials | | Maximum 1% | | | | | | RMS T276 | | Type III Foreign Materials excluding bitumen | | Maximum 0.5% | | | | | | AS/NZS 2891.3.3 | | Bitumen Content | | Maximum 1% | | | | |     **CLASS 2 RECYCLED PAVEMENT MATERIAL [PERFORMANCE BASED]**  **SOURCE MATERIALS**  Source materials may be quarried material, reclaimed concrete or any combination of them. Supplementary source materials may comprise brick, tile and asphalt. Asbestos or asbestos fibre must not be incorporated into the product under any circumstances. No more than 20% by mass of supplementary materials may be incorporated and the constituent proportions must remain unchanged during production.  **NOMINATED MIX DESIGN PARAMETERS**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | MIX DESIGN LIMITS | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | Particle Size Distribution  TP134 | | **PRODUCT** | | **20 mm Class 2**  **PM 2/20RM** | **30 mm Class 2**  **PM 2/30RM** | | Sieve Size (mm) | | Percent Passing | | | 37.5 | |  | 100 | |  | | 26.5 | | 100 | 90 – 100 | |  | | 19 | | 90 – 100 | 80 – 95 | | 2.36 | | 30 – 60 | 25 – 55 | | 0.075 | | 5 – 20 | 5 – 20 | | AS 1289.3.1.2 | Liquid Limit | | Maximum 30% | | | | | | AS 1289.3.3.1 | Plasticity Index | | Minimum 1% - Maximum 10% | | | | | | AS 1289.3.4.1 | Linear Shrinkage | | Maximum 5% | | | | | | TP183 | Resilient Modulus | | Minimum 250 MPa | | | | | | TP183 | Deformation | | Maximum 10-7 | | | | | | AS 1141.23 | LA Abrasion Grading ‘B’ | | Contractor Nominated Value | | | | | | TP184 | Triaxial Compression | | Cohesion Max 250 kPa, Friction Angle Min 400 | | | | | RMS T276 | Type II Foreign Materials | | Maximum 1% | | | | | | RMS T276 | Type III Foreign Materials excluding bitumen | | Maximum 0.5% | | | | | | AS/NZS 2891.3.3 | Bitumen Content | | Maximum 1% | | | | |   **PRODUCT QUALITY CONTROL**   |  |  |  | | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | Particle Size Distribution  TP134 | Sieve Size (mm) | Percent Passing | | 37.5 | 0 | | 26.5 | 0 (PM2/20), +/-6 (PM2/30) | | 19 | +/-6 | | 9.5 | +/-9 | | 2.36 | +/-8 | | 0.075 | +/-3 | | AS 1289.3.1.2 | Liquid Limit | +3 | | AS 1289.3.3.1 | Plasticity Index | +2 | | AS 1289.3.4.1 | Linear Shrinkage | +1 | | AS 1141.23 | LA Abrasion Grading ‘B’ | +3 |     **CLASS 2 QUARRIED PAVEMENT MATERIAL [GRADING BASED]**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MANUFACTURING TOLERANCE [Grading Based] | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | | | Particle Size Distribution  TP134 | | **Product** | | **20 mm Class 2**  **PM 2/20QG** | **30 mm Class 2**  **PM 2/30QG** | | **40 mm Class 2**  **PM 2/40QG** | | | Sieve Size (mm) | | Percent Passing | | | | | | 53 | |  |  | | 100 | | | 37.5 | |  | 100 | | 90 – 100 | | | 26.5 | | 100 | 90 – 100 | | 74 – 96 | | | 19 | | 90 – 100 | 77 – 95 | | 62 – 86 | | | 13.2 | | 74 – 96 |  | |  | | | 9.5 | | 61 – 85 | 51 – 75 | | 42 – 66 | | | 4.75 | | 42 – 66 | 35 – 57 | | 28 – 50 | | | 2.36 | | 28 – 50 | 24 – 44 | | 20 – 39 | | | 0.425 | | 11 – 27 | 9 – 22 | | 8 – 21 | | | 0.075 | | 4 – 14 | 4 - 12 | | 3 – 11 | | | AS 1289.3.1.2 | | Liquid Limit | | Maximum 28% | | | | | | AS 1289.3.3.1 | | Plasticity Index | | Minimum 1% - Maximum 8% | | | | | | AS 1289.3.4.1 | | Linear Shrinkage | | Maximum 4% | | | | | | AS 1141.23 | LA Abrasion  Grading ‘A’ | | N.A. | | | N.A. | | Maximum 45% | | | AS 1141.23 | LA Abrasion  Grading ‘B’ | | Maximum 45% | | | Maximum 45% | | N.A. | |   Note: 1. Blast furnace slag can be substituted for quarried material subject to Part R15 Clause 6.    **CLASS 2 QUARRIED PAVEMENT MATERIAL [PERFORMANCE BASED]**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **NOMINATED MIX DESIGN PARAMETERS**   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MIX DESIGN LIMITS | | | | | | **QUALITY CONTROL TESTS** | | | | | | | Particle Size Distribution  TP134 | **PRODUCT** | | **20 mm Class 2**  **PM 2/20QM** | | **30 mm Class 2**  **PM 2/30QM** | | Sieve Size (mm) | | Percent Passing | | | | 37.5 | |  | | 100 | | 26.5 | | 100 | | 90 – 100 | | 19 | | 90 – 100 | | 80 – 95 | | 9.5 | |  | |  | | 2.36 | | 30 – 60 | | 25 – 55 | | 0.075 | | 5 – 20 | | 5 – 20 | | AS 1289.3.1.2 | | Liquid Limit | | Maximum 30% | | | | AS 1289.3.3.1 | | Plasticity Index | | Minimum 1% - Maximum 10% | | | | AS 1289.3.4.1 | | Linear Shrinkage | | Maximum 5% | | | | TP183 | | Resilient Modulus | | Minimum 250 MPa | | | | TP183 | | Deformation | | Maximum 10-7 | | | | TP184 | | Triaxial Compression | | Cohesion Max 250 kPa, Friction Angle Min 400 | | | | AS 1141.23 | | LA Abrasion Grading ‘B’ | | Contractor Nominated Value | | |   **PRODUCT QUALITY CONTROL**   |  |  |  |  | | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | Particle Size Distribution  TP134 | | Sieve Size (mm) | Percent Passing | | 37.5 | 0 | | 26.5 | 0 (PM2/20), +/-6 (PM2/30) | | 19 | +/-6 | | 9.5 | +/-8 | | 2.36 | +/-6 | | 0.075 | +/-2 | | AS 1289.3.1.2 | | Liquid Limit | +3 | | AS 1289.3.3.1 | | Plasticity Index | +2 | | AS 1289.3.4.1 | | Linear Shrinkage | +1 | | AS 1141.23 | | LA Abrasion Grading ‘B’ | +3 |   Note: 1. Blast furnace slag can be substituted for quarried material subject to Part R15 Clause 6.  2. Refer to the Contractor’s current Mix Design certificate to assess compliance.    **CLASS 1 RECYCLED PAVEMENT MATERIAL [GRADING BASED]**  **SOURCE MATERIALS**  Source materials may be quarried material, reclaimed concrete or any combination of them. Supplementary source materials may comprise brick, tile and asphalt. Asbestos or asbestos fibre must not be incorporated into the product under any circumstances. No more than 20% by mass of supplementary materials may be incorporated and the constituent proportions must remain unchanged during production.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MANUFACTURING TOLERANCE [Grading Based] | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | | | Particle Size Distribution  TP134 | | **Product** | | **20 mm Class 1**  **PM 1/20RG** | **30 mm Class 1**  **PM 1/30RG** | | **40 mm Class 1**  **PM 1/40RG** | | | Sieve Size (mm) | | Percent Passing | | | | | | 53 | |  |  | | 100 | | | 37.5 | |  | 100 | | 95 – 100 | | | 26.5 | | 100 | 95 – 100 | | 79 – 91 | | | 19 | | 95 – 100 | 79 – 93 | | 65 – 83 | | | 13.2 | | 77 – 93 |  | |  | | | 9.5 | | 63 – 83 | 53 – 73 | | 44 – 64 | | | 4.75 | | 44 – 64 | 36 – 56 | | 29 – 49 | | | 2.36 | | 29 – 49 | 25 – 43 | | 20 – 38 | | | 0.425 | | 13 – 23 | 10 – 21 | | 8 – 18 | | | 0.075 | | 5 – 11 | 4 - 10 | | 3 – 9 | | | AS 1289.3.1.2 | | Liquid Limit | | Maximum 25% | | | | | | AS 1289.3.3.1 | | Plasticity Index | | Minimum 1% Maximum 6% | | | | | | AS 1289.3.4.1 | | Linear Shrinkage | | Maximum 3% | | | | | | AS 1141.23 | LA Abrasion Grading ‘A’ | | N.A. | | | N.A. | | Maximum 30% | | | AS 1141.23 | LA Abrasion Grading ‘B’ | | Maximum 30% | | | Maximum 30% | | N.A. | | | RMS T276 | | Type II Foreign Materials | | Maximum 1% | | | | | | RMS T276 | | Type III Foreign Materials excluding bitumen | | Maximum 0.5% | | | | | | AS/NZS 2891.3.3 | | Bitumen Content | | Maximum 1% | | | | |   NOTE: The recycled pavement material must have a uniform grading and must not be graded from the coarse limit of the grading envelope to the fine limit of the grading envelope, or vice versa.    **CLASS 1 RECYCLED PAVEMENT MATERIAL [PERFORMANCE BASED]**  **SOURCE MATERIALS**  Source materials may be quarried material, reclaimed concrete or any combination of them. Supplementary source materials may comprise brick, tile and asphalt. Asbestos or asbestos fibre must not be incorporated into the product under any circumstances. No more than 20% by mass of supplementary materials may be incorporated and the constituent proportions must remain unchanged during production.  **NOMINATED MIX DESIGN PARAMETERS**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MIX DESIGN LIMITS | | | | | **QUALITY CONTROL TESTS** | | | | | | | Particle Size Distribution  TP134 | **PRODUCT** | | **20 mm Class 1**  **PM 1/20RM** | | **30 mm Class 1**  **PM 1/30RM** | | Sieve Size (mm) | | Percent Passing | | | | 37.5 | |  | | 100 | | 26.5 | | 100 | |  | | 19 | | 95 – 100 | | 80 – 95 | | 9.5 | | 65 – 85 | | 50 – 75 | | 2.36 | | 30 – 50 | | 25 – 45 | | 0.075 | | 5 – 15 | | 5 – 15 | | AS 1289.3.1.2 | | Liquid Limit | | Maximum 25% | | | AS 1289.3.3.1 | | Plasticity Index | | Minimum 1% - Maximum 6% | | | AS 1289.3.4.1 | | Linear Shrinkage | | Maximum 3% | | | TP183 | Resilient Modulus | | | Minimum 300 MPa | | | TP183 | Deformation | | | Maximum 10-8 | | | AS 1141.23 | | LA Abrasion Grading ‘B’ | | Contractor Nominated Value | | | TP184 | | Triaxial Compression | | Cohesion Max 150 kPa, Friction Angle Min 450 | | | RMS T276 | | Type II Foreign Materials | | Maximum 1% | | | RMS T276 | | Type III Foreign Materials excluding bitumen | | Maximum 0.5% | | | AS/NZS 2891.3.3 | | Bitumen Content | | Maximum 1% | |   **PRODUCT QUALITY CONTROL**   |  |  |  |  | | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | Particle Size Distribution  TP134 | | Sieve Size (mm) | Percent Passing | | 37.5 | 0 | | 26.5 | 0 (PM1/20), +/-6 (PM1/30) | | 19 | +/-6 | | 9.5 | +/-9 | | 2.36 | +/-8 | | 0.075 | +/-3 | | AS 1289.3.1.2 | | Liquid Limit | +3 | | AS 1289.3.3.1 | | Plasticity Index | +2 | | AS 1289.3.4.1 | | Linear Shrinkage | +1 | | AS 1141.23 | | LA Abrasion Grading ‘B’ | +3 |   Note: 1. Refer to the Contractor’s current Mix Design certificate to assess compliance    **CLASS 1 QUARRIED PAVEMENT MATERIAL [GRADING BASED]**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MANUFACTURING TOLERANCE [Grading based] | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | | | Particle Size Distribution  TP134 | | **PRODUCT** | | **20 mm Class 1**  **PM 1/20QG** | **30 mm Class 1**  **PM 1/30QG** | | **40 mm Class 1**  **PM 1/40QG** | | | Sieve Size (mm) | | Percent Passing | | | | | | 53 | |  |  | | 100 | | | 37.5 | |  | 100 | | 95 – 100 | | | 26.5 | | 100 | 95 – 100 | | 79 – 91 | | | 19 | | 95 – 100 | 79 – 93 | | 65 – 83 | | | 13.2 | | 77 – 93 |  | |  | | | 9.5 | | 63 – 83 | 53 – 73 | | 44 – 64 | | | 4.75 | | 44 – 64 | 36 – 56 | | 29 – 49 | | | 2.36 | | 29 – 49 | 25 – 43 | | 20 – 38 | | | 0.425 | | 13 – 23 | 10 – 21 | | 8 – 18 | | | 0.075 | | 5 – 11 | 4 – 10 | | 3 – 9 | | | AS 1289.3.1.2 | | Liquid Limit | | Maximum 25% | | | | | | AS 1289.3.3.1 | | Plasticity Index | | Minimum 1% Maximum 6% | | | | | | AS 1289.3.4.1 | | Linear Shrinkage | | Maximum 3% | | | | | | AS 1141.23 | LA Abrasion Grading ‘A’ | | N.A. | | | N.A. | | Maximum 30% | | | AS 1141.23 | LA Abrasion Grading ‘B’ | | Maximum 30% | | | Maximum 30% | | N.A. | |   NOTES:   1. Blast furnace slag can be substituted for quarried material subject to Part R15 Clause 6. 2. The quarried pavement material must have a uniform grading and must not be graded from the coarse limit of the grading envelope to the fine limit of the grading envelope, or vice versa.     **CLASS 1 QUARRIED PAVEMENT MATERIAL [PERFORMANCE BASED]**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **NOMINATED MIX DESIGN PARAMETERS**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | TEST PROCEDURE | MIX DESIGN LIMITS | | | | | **QUALITY CONTROL TESTS** | | | | | | Particle Size Distribution  TP134 | **PRODUCT** | **20 mm Class 1**  **PM 1/20QM** | | **30 mm Class 1**  **PM 1/30QM** | | Sieve Size (mm) | Percent Passing | | | | 37.5 |  | | 100 | | 26.5 | 100 | |  | | 19 | 95 – 100 | | 80 – 95 | | 9.5 | 65 – 85 | | 50 – 75 | | 2.36 | 30 – 50 | | 25 – 45 | | 0.075 | 5 – 15 | | 5 – 15 | | AS 1289.3.1.2 | Liquid Limit | Maximum 25% | | | | AS 1289.3.3.1 | Plasticity Index | Minimum 1% - Maximum 6% | | | | AS 1289.3.4.1 | Linear Shrinkage | Maximum 3% | | | | TP183 | Resilient Modulus | | Minimum 300 MPa | | | TP183 | Deformation | | Maximum 10-8 | | | AS 1141.23 | LA Abrasion Grading ‘B’ | Contractor Nominated Value | | | | TP184 | Triaxial Compression | Cohesion Max 150 kPa, Friction Angle Min 450 | | |   **PRODUCT QUALITY CONTROL**   |  |  |  |  | | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | Particle Size Distribution  TP134 | | Sieve Size (mm) | Percent Passing | | 37.5 | 0 | | 26.5 | 0 (PM1/20), +/-6 (PM1/30) | | 19 | +/-6 | | 9.5 | +/-8 | | 2.36 | +/-6 | | 0.075 | +/-2 | | AS 1289.3.1.2 | | Liquid Limit | +3 | | AS 1289.3.3.1 | | Plasticity Index | +2 | | AS 1289.3.4.1 | | Linear Shrinkage | +1 | | AS 1141.23 | | LA Abrasion Grading ‘B’ | +3 |   Note: 1. Refer to the Contractor’s current Mix Design certificate to assess compliance.  **CLASS 1 HEAVY DUTY QUARRIED PAVEMENT MATERIAL**  **[GRADING BASED]**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE [Grading based] | | | | | **QUALITY CONTROL TESTS** | | | | | | Particle Size Distribution  TP134 | **Product** | **20 mm Class 1A**  **PM 1A/20QG** | | | | Percent Passing | | Percent Retained | | | Sieve Size (mm) | % | Size Range (mm) | % | | 37.5 |  |  |  | | 26.5 | 100 | 26.5 – 19.0 | 0 - 5 | | 19.0 | 95 – 100 | 19.0 – 13.2 | 7 - 18 | | 13.2 | 78 – 92 | 13.2 – 9.5 | 10 - 16 | | 9.5 | 63 – 83 | 9.5 – 4.75 | 14 - 24 | | 4.75 | 44 – 64 | 4.75 – 2.36 | 10 - 20 | | 2.36 | 30 – 48 | 2.36 – 0.425 | 14 - 28 | | 0.425 | 14 – 22 | 0.425 – 0.075 | 6 - 13 | | 0.075 | 7 – 11 |  |  | | AS 1289.3.1.2 | Liquid Limit | Maximum 25% | | | | AS 1289.3.3.1 | Plasticity Index | Minimum 2% Maximum 6% | | | | AS 1289.3.4.1 | Linear Shrinkage | Maximum 3% | | | | AS 1141.23 | LA Abrasion Grading ‘B’ | Maximum 25% | | |   **OR**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE [Grading based] | | | | | **QUALITY CONTROL TESTS** | | | | | | Particle Size Distribution  TP134 | **Product** | **20 mm Class 1B**  **PM 1B/20QG** | | | | Percent Passing | | Percent Retained | | | Sieve Size (mm) | % | Size Range (mm) | % | | 37.5 |  |  |  | | 26.5 | 100 | 26.5 – 19.0 | 0 - 5 | | 19.0 | 95 – 100 | 19.0 – 13.2 | 7 - 18 | | 13.2 | 78 – 92 | 13.2 – 9.5 | 10 - 16 | | 9.5 | 63 – 83 | 9.5 – 4.75 | 14 - 24 | | 4.75 | 44 – 64 | 4.75 – 2.36 | 10 - 20 | | 2.36 | 29 – 48 | 2.36 – 0.425 | 15 – 29 | | 0.425 | 13 – 21 | 0.425 – 0.075 | 7 – 14 | | 0.075 | 5 – 9 |  |  | | AS 1289.3.1.2 | Liquid Limit | Maximum 25% | | | | AS 1289.3.3.1 | Plasticity Index | Minimum 2% Maximum 6% | | | | AS 1289.3.4.1 | Linear Shrinkage | Maximum 3% | | | | AS 1141.23 | LA Abrasion Grading ‘B’ | Minimum 25% - Maximum 30% | | |   **STABILISED PAVEMENT MATERIAL [BINDER CONTROL]**  **SOURCE MATERIALS**  Source materials must be natural quarried material OR, where approved, recycled materials.  **RAW FEED PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE [Grading Based] | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | | Particle Size Distribution  TP134 | **Product** | | **20 mm Class 2**  **PM 2/20\*** | **30 mm Class 2**  **PM 2/30\*** | | **40 mm Class 2**  **PM 2/40\*** | | | Sieve Size (mm) | | Percent Passing | | | | | | 53 | |  |  | | 100 | | | 37.5 | |  | 100 | | 90 – 100 | | | 26.5 | | 100 | 90 – 100 | | 74 – 96 | | | 19 | | 90 – 100 | 77 – 95 | | 62 – 86 | | | 13.2 | | 74 – 96 |  | |  | | | 9.5 | | 61 – 85 | 51 – 75 | | 42 – 66 | | | 4.75 | | 42 – 66 | 35 – 57 | | 28 – 50 | | | 2.36 | | 28 – 50 | 24 – 44 | | 20 – 39 | | | 0.425 | | 11 – 27 | 9 – 22 | | 8 – 21 | | | 0.075 | | 4 – 14 | 4 – 12 | | 3 – 11 | | | AS 1289.3.1.2 | Liquid Limit | | Maximum 28% | | | | | | AS 1289.3.3.1 | Plasticity Index | | Minimum 1% - Maximum 8% | | | | | | AS 1289.3.4.1 | Linear Shrinkage | | Maximum 4% | | | | | | AS 1141.23 | LA Abrasion Grading ‘A’ | N.A. | | | N.A. | | Maximum 45% | | AS 1141.23 | LA Abrasion Grading ‘B’ | Maximum 45% | | | Maximum 45% | | N.A. |   **STABILISED PRODUCT QUALITY CONTROL**   |  |  |  | | --- | --- | --- | | **Test** | **Product** | Refer R15.8 for nomenclature | | Contractor Quality Plan | Target Binder Content (% dry mass) | Within the tolerance specified in clause R15.8 under “Additive Content Determination” of the binder content specified in the material description in accordance with clause R15.8 under “General”. | | AS 1141.51 | Unconfined Compressive Strength  (96% MDD - 7 days curing) | Reported Value | | AS 1141.51 | Unconfined Compressive Strength  (96% MDD - 28 days curing) | Strength must not be less than the value specified in the material description in accordance with clause R15. under “General”. |   \*Raw feed material must be: PM2/20QG, PM2/30QG, PM2/40QG, OR, with prior approval, PM2/20RG, PM2/30RG or PM2/40RG.  The Principal may specify Class 1 Quarried, Recycled or Performance Based materials as an alternative to Class 2 Pavement Material (Grading Based). When Class 1 materials are specified, Product Quality Control criteria for the appropriate Class 1 Pavement Material must apply.  **STABILISED PAVEMENT MATERIAL [STRENGTH CONTROL]**  **SOURCE MATERIALS**  Source materials must be natural quarried material OR, where approved, recycled materials.  **RAW FEED PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE [Grading Based] | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | Particle Size Distribution  TP134 | **Product** | **20 mm Class 2**  **PM 2/20\*** | | **30 mm Class 2**  **PM 2/30\*** | **40 mm Class 2**  **PM 2/40\*** | | | Sieve Size (mm) | Percent Passing | | | | | | 53 |  | |  | 100 | | | 37.5 |  | | 100 | 90 – 100 | | | 26.5 | 100 | | 90 – 100 | 74 – 96 | | | 19 | 90 – 100 | | 77 – 95 | 62 – 86 | | | 13.2 | 74 – 96 | |  |  | | | 9.5 | 61 – 85 | | 51 – 75 | 42 – 66 | | | 4.75 | 42 – 66 | | 35 – 57 | 28 – 50 | | | 2.36 | 28 – 50 | | 24 – 44 | 20 – 39 | | | 0.425 | 11 – 27 | | 9 – 22 | 8 – 21 | | | 0.075 | 4 – 14 | | 4 – 12 | 3 – 11 | | | AS 1289.3.1.2 | Liquid Limit | Maximum 28% | | | | | | AS 1289.3.3.1 | Plasticity Index | Minimum 1% - Maximum 8% | | | | | | AS 1289.3.4.1 | Linear Shrinkage | Maximum 4% | | | | | | AS 1141.23 | LA Abrasion Grading ‘A’ | N.A. | N.A. | | | Maximum 45% | | | AS 1141.23 | LA Abrasion Grading ‘B’ | Maximum 45% | Maximum 45% | | | N.A. | |   **STABILISED PRODUCT QUALITY CONTROL**   |  |  |  | | --- | --- | --- | | **Test** | **Product** | Refer R15.8 for nomenclature | | Contractor Quality Plan | Target Binder Content (% dry mass) | Within the tolerance specified in clause R15.8 under “Additive Content Determination” of the binder content specified in the material description in accordance with clause R15.8 under “General”. | | AS 1141.51 | Unconfined Compressive Strength  (96% MDD - 7 days curing) | Reported Value | | AS 1141.51 | Unconfined Compressive Strength  (96% MDD - 28 days curing) | Strength must not be less than the value specified in the material description in accordance with clause R15.8 under “General” |   \*Raw feed material must be: PM2/20QG, PM2/30QG, PM2/40QG, OR, with prior approval, PM2/20RG, PM2/30RG or PM2/40RG.  The Principal may specify Class 1 Quarried, Recycled or Performance Based materials as an alternative to Class 2 Pavement Material (Grading Based). ). When Class 1 materials are specified, Product Quality Control criteria for the appropriate Class 1 Pavement Material must apply.  **SEALING AGGREGATE**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | | MANUFACTURING TOLERANCE | | | | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | | | | | | Particle Size Distribution  AS 1141.11 | | **Product** | **SA 20-14** | **SA 16-10** | | | **SA 14-10** | **SA 10-7** | | **SA 7-5** | **SA 5-2** | | Sieve Size (mm) | Percent Passing | | | | | | | | | | 26.5 | 100 |  | | |  |  | |  |  | | 19 | 95 – 100 | 100 | | |  |  | |  |  | | 16 | 35 – 65 | 65 – 90 | | | 100 |  | |  |  | | 13.2 | 0 – 10 | 15 – 40 | | | 90 – 100 | 100 | |  |  | | 9.5 | 0 – 2 | 0 – 8 | | | 0 – 15 | 85 – 100 | | 100 |  | | 6.7 |  | 0 – 2 | | | 0 – 2 | 0 – 15 | | 80 – 100 | 100 | | 4.75 |  |  | | |  | 0 – 3 | | 0 - 20 | 80 – 100 | | 2.36 |  |  | | |  |  | | 0 - 5 | 0 – 10 | | 1.18 | 0 – 1 | 0 – 1 | | | 0 – 1 | 0 – 1 | | 0 - 1 | 0 – 1 | | AS 1141.15 | | Flakiness Index | Maximum 25% | | | | | | | Reported Value | N/A | | TP244 | | % Flat Particles | N/A | | | | | | | Maximum 35% | N/A | | AS 1141.14 [3] | | Mis-shapen Particles % | Reported Value | | | | | | N/A | | | | AS 1141.23 | | LA Abrasion  Grading H | Max 25% | |  | | | N/A | | | | | AS 1141.23 | | LA Abrasion  Grading J | N/A | | | Max 25% | | N/A | | | | | AS 1141.23 | | LA Abrasion  Grading K | N/A | | | | | Maximum 25% | | Maximum 30% | Maximum 30% (1) | | AS 1141 42/40[1] | | PAFV | Min 48[2] | Minimum 45[2] | | | | | | | | | TP705[1] | | Aggregate Stripping | Maximum 15% Wet and Maximum 5% Dry | | | | | | | | | | AS 1141.20.1 | ALD – Direct | | Reported Value | | | | | | | N/A | | | AS 1141.20.2 | ALD - Direct | | N/A | | | | | | | Reported Value | | | AS 1141.20.3 | ALD – Calculated | | Reported Value | | | | | | | N/A | |  1. Sample must be prepared from an appropriately sized fraction of identical source rock. 2. A minimum value of 55 must apply to sites requiring high skid resistance. 3. Calliper Ratio = 2:1; report each of % flat, elongated, and flat and elongated particles.   **SAND**  **SOURCE MATERIALS**  **Type A and B** Must be washed or unwashed natural pit, river or crushed quarry material.  **Type C** Must be a crushed quarry product only.  **Type D** Must be a natural pit material, dune sand or crushed quarry product.  **PRODUCT QUALITY CONTROL**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | | | **QUALITY CONTROL TESTS** | | | | | | | Particle Size Distribution  TP134 | **Product** | **Sa - A** | **Sa - B** | **Sa – C** | **Sa – D** | | Sieve Size (mm) | Percent Passing | | | | | 9.5 | 100 | 100 |  |  | | 6.7 |  |  | 100 | 95 – 100 | | 4.75 | 95 – 100 | 95 – 100 | 70 – 100 |  | | 2.36 | 75 – 100 | 75 – 100 | 35 – 100 |  | | 1.18 | 55 – 90 | 45 – 90 |  |  | | 0.600 | 35 – 70 | 30 – 70 |  |  | | 0.425 |  |  | 25 – 70 |  | | 0.300 | 20 – 40 | 20 – 42 |  |  | | 0.150 | 5 – 20 | 15 – 30 |  |  | | 0.075 | 0 - 10 | 5 – 20 | 8 – 23 | 0 – 10 | | AS 1289.3.1.2 | Liquid Limit | Non Plastic | Max 25% | | Non Plastic | | AS 1289.3.3.1 | Plasticity Index | Max 6% | | | AS 1289.3.4.1 | Linear Shrinkage | Max 3% | | | AS 1141.34 | Organic Impurities | Satisfactory | | | |   **ASPHALT AGGREGATE**  **SOURCE MATERIALS**  Source materials must be natural quarried material. No recycled material is permitted to be included. Highly micaceous materials such as granite and gneiss should not be used for Asphalt Aggregates unless the Contractor can provide evidence that the aggregate particles will maintain long term strength and not exfoliate when subject to processing through an asphalt plant (or equivalent).  Materials of the same size from two or more sources must not be mixed  **PRODUCT QUALITY CONTROL**  Percentage Tolerances for the Assessment of Conformity of Aggregate and Sand Production   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Percentage Passing** | **Tolerance about target composition of aggregate size D-d\*** | | | | |  | **Small aggregate**  **(D ≤ 20)** | **Large aggregate**  **(D.> 20)** | **Natural Sand** | **Quarry Sand** | | **One sieve less than D** | ±8 | ±10 |  |  | | **Closest sieve to d** | ±2.5 | ±5 |  |  | | **2.36 mm sieve** | - | - | ±5 | ±5 | | **1.18 mm sieve** | ±0.5 | ±0.5 | ±4 | ±4 | | **0.075 mm sieve** |  |  | ±3 | ±3 |   \*Aggregate size D-d, e.g. 10-7   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | | | | | | **QUALITY CONTROL TESTS** | | | | | | | | |  | **Product5** | **Coarse Fraction**  **(-37.5mm+ 19.0mm)** | **Medium Fraction**  **(-19.0mm + 6.7mm)** | **Fine Fraction**  **(-6.7mm + 2.36mm)** | **Natural Sand** | **Quarry Sand** | | | AS 1141.24 | Sulphate Soundness | Maximum 12 | | | Maximum 15 | | | | AS 1141.30 | Unsound & Marginal Stone Content | Maximum 5% (unsound stone)6  Maximum 10% (marginal& unsound stone) | | |  | | | | AS 1141.15 | Flakiness Index | Maximum 30 | Maximum 30 |  | N/A | | | | TP 240 | Elongation Index | Maximum 35 | Maximum 35 |  |  | | | | AS 1141.23 | LA Abrasion  Max % | Maximum 35 | Maximum 25 | Maximum 30 |  | | | | AS 1289.3.1.2 | Liquid Limit |  | | |  | | Max. 25 | | AS 1289.3.3.1 | Plasticity index | NP | | Max 61 | | AS 1289.3.4.1 | Linear shrinkage |  | | Max 3 | | AS1141.34 | Organic impurities |  | | | Satisfactory | | | | AS 1141 42/402 | PAFV4 | - | Minimum 483 | - | N/A | | | | AS1141.5, AS1141.6.1 & AS1141.6.2 | Water absorption & densities | Report Only | | | | | |   1. Sand may be non-plastic.  2. Sample must be prepared from an appropriately sized fraction of identical source rock.  3. A minimum value of 55 must apply to all OG and SMA Asphalt mixes. A minimum value of 55 must also apply to specified sites requiring high skid resistance.  4. Aggregates within -9.5 mm to +6.7 mm fraction, prepared in accordance with AS 1141.40 Section 7.1.  5. ‘Product’ for asphalt aggregates refers to the fractions of individual asphalt aggregate products used in the asphalt mix; common asphalt aggregate products include 35/20 mm, 20/14 mm, 10/7 mm and 7/2 mm.  6. Refer to “Additional Requirements for Basic Igneous Source Rock” for criteria which takes precedence where basic igneous source rock is used.  **MINERAL FILLER FOR ASPHALT, OTHER THAN HYDRATED LIME**  **PRODUCT QUALITY CONTROL**   |  |  |  |  | | --- | --- | --- | --- | | TEST PROCEDURE | | MANUFACTURING TOLERANCE | | | AS 1141.11 | Gradings (0.60, 0.3 & 0.075 mm sieves) (%) | | Report Only | | AS 1141.17 | Voids in Dry Compacted Filler (%) | | Report Only | | AS 1289.B1.3 | Moisture Content (%) | | 3% maximum | | AS 2350.8 | Specific Surface (square metres per kilogram) | | Report Only | | AS 3583.3 | Loss on Ignition (% by mass) | | 4% maximum | | AS 1141.8 | Water Soluble Fraction (% by mass) | | 20% maximum |   **ADDITIONAL REQUIREMENTS FOR BASIC IGNEOUS SOURCE ROCK**  This clause applies where basic igneous source rock (as defined in AS 2758) is used for the production of a Pavement Material complying with this Part R15. The presence of Secondary Minerals must not have a deleterious effect of the Pavement Material’s intended performance.  The Source Rock must be classified in accordance with the following:   |  |  |  | | --- | --- | --- | | **Rock Classification** | **Secondary Mineral Content (%) AS1142.6** | **Accelerated Soundness Index AS 1141.29** | | Sound Rock | < 25 | > 94 | | Marginal Rock | 26‑30 | 90‑93 | | Unsound Rock | > 30 | < 90 |   Unsound and marginal rock in that fraction of the product retained on a 4.75 mm AS sieve must not exceed the percentages specified below:   |  |  |  | | --- | --- | --- | | **Material Class** | **Total of Marginal and Unsound Rock**  **% (max)** | **Unsound Rock**  **% (max)** | | PM 1 | 10 | 5 | | PM 2 | 10 | 7 | | PM 3 | 20 | 10 | | Sealing and Asphalt Aggregate | 10 | 3 |   **ARRESTOR BED MATERIAL**  **SOURCE MATERIALS**  Arrestor bed material shall have a smooth surface and be relatively spherical, well-rounded, hard and durable. Source materials shall be from a natural source such as river gravel, and be uncrushed, unblended and from a single quarry.  No recycled material is permitted to be included. Arrestor bed material shall be free of deleterious inclusions such as concrete, bitumen, bricks, and organic matter.  **PRODUCT QUALITY CONTROL**   |  |  |  | | --- | --- | --- | | TEST PROCEDURE | MANUFACTURING TOLERANCE | | | Particle Size Distribution  TP134 | Sieve Size (mm) | Percent Passing | | 19 | 100 | | 9.5 | 0 – 5 | | 0.075 | Maximum 2 | | RMS T239 | Fractured Faces | Maximum 10% | | AS 1141.14 [1] | Mis-shapen Particles % | Maximum 10% | | WA 223.1 | Crushing | Maximum 5% | | AS 1141.23 | Los Angeles Value  Grading B | Report Only | | WA 223.1 | Cracking | Maximum 5% | | WA Specification 6706/02/1312 Attachment[2] | Slump Angle | Maximum 30° | | AS 1141.4 | Bulk Density | Maximum 3.4 tonnes/m3 |   **Notes:**   1. Calliper Ratio = 2:1; report each of % flat, elongated, and flat and elongated particles. 2. Also report measured radius points and height of slump; repeat the test for a non-inverted cone.   \_\_\_\_\_\_\_\_\_\_\_\_ | **ATTACHMENT R15A**    **PAVEMENT MATERIAL SPECIFICATION**  **LIST OF PRODUCTS**  For more information on these products, please refer to the corresponding product sheets.  Spalls  Spalls are not a significant item in terms of demand. They may be used occasionally for soft spots repair, or for gabion baskets.  Road Ballast  Road ballast is not a significant item in terms of demand. It may be used occasionally for drainage layers in combination with geotextile separation membranes or for a macadam pavement layer. Macadam pavements are commonly found as older pavements constructed during the 19th to the mid-20th century, but are less common in more modern pavements due to the cost of construction. The lower 200 mm of pavement comprised particles up to 75 mm in size while the upper 50 mm was a finer grading to interlock with the larger stone below and provide a solid surface for vehicular traffic. Macadam pavements may be bound with tar or bitumen which acted to bind the surface layers, reduce dust emissions and prevent ravelling of the surface. They provide a very strong flexible pavement structure. Macadam pavements are still in service in Adelaide and when in sound structural condition can be readily rehabilitated by asphalt profiling and overlay techniques.  Rail Ballast  Rail ballast was added to the Master Specification in 2009.  Rail ballastcould also be used for soft spot repair, drainage layers, or scour mattresses.  Granular Road Base Materials (Class 1, 2 and 3 Quarried and Recycled Pavement Materials; Grading and Performance Based)  The product identification codes are explained as follows; for example, for PM1/20 QG:   * ‘PM’ = Pavement Material * ‘1’ = Class 1 * ‘20’ = 20 mm * ‘Q’ = Quarried (alternative suffix of ‘R’ = recycled) * ‘G’ = Grading based (alternative suffix of ‘M’ = performance based)     ‘Granular pavement materials are described in terms of classes based on their intended purpose. Class 1 represents the strongest category for high traffic applications while Class 3 is intended for low traffic unsealed rural situations using natural or lightly processed pit rubbles, or as foundation layers for more heavily trafficked roads. Class 2 material is intended for intermediate traffic applications or for sub-base layers on heavily trafficked pavements at the discretion of the pavement designer.’ [2] The commercial value of products is generally in the order of Class 1 (highest value) to Class 3 (lowest value).  ‘The quality and strength characteristics required of granular materials depends upon the following factors and their interactions: traffic (volume, axle group types and loads); climate; pavement configuration and drainage; subgrade. Lightly trafficked roads in dry environments can more successfully use lower quality granular materials than roads with higher traffic loadings in wet environments.’ [5]  A description of the typical uses for the granular road base materials is as follows [5]:   * Class 1:   + Base layer(s) (highest quality).   + Feed for cement treated pugmill mixed bound products. * Class 2:   + Upper sub-base, lower sub-base, working platforms for heavily and moderately trafficked roads and base for lightly trafficked roads.   + Sheeting and shoulder material for unsealed roads.   + Feed for cement treated pugmill mixed bound products. * Class 3:   + Working platforms for moderately trafficked roads and lower sub-base layers for lightly trafficked roads.   + Sheeting and shoulder material for unsealed roads.   Class 2 materials are preferred over Class 1 for unsealed shoulders due to the higher plasticity index. For unsealed applications a minimum PI is required, based on DPTI research work. A higher plasticity index for unsealed shoulders is desirable for two reasons:   * To reduce permeability of the shoulder thereby increasing the ability of the shoulder to resist moisture penetration and resultant loss of load bearing capacity and stiffness * To increase cohesion of the gravel shoulder when dry to resist ravelling from the action of traffic and erosion by wind and water   Size 40 mm materials are unsuitable as base layers as they tend to segregate during placement and do not provide adequate surface tightness and finish. [5]  Stabilised Pavement Material  Stabilised pavement materials are specified as “Binder” or “Strength” control. These materials can be used as cemented sub-base for urban roads.  Sealing Aggregate  Sealing aggregates (also can be known as ‘chippings’) are specified by nominal maximum and minimum size, e.g. 20-14mm.  ‘The size of aggregate selected will vary according to the expected volume and composition of traffic. In general, a 14/7 double seal is appropriate as an initial surfacing treatment on a granular pavement (note that a ‘14/7 double seal’ refers to two products used, not to an aggregate size). However, where traffic volumes exceed 2000 vehicles/lane/day or the percentage of heavy vehicles exceeds 15%, a 16/7 double seal should be considered.’ [5].  SA 20-14 has not generally been used by DPTI in recent years due to the high application rate and cost of binder required. Its coarse texture also generates increased tyre noise.  Sand  Sand is specified by historical “Type” to cover natural sands and crushed sand by-products. Materials are used as pipe bedding sand, or in asphalt.  Type A and B sands are well graded washed or unwashed, natural or manufactured sands and may be appropriate for asphalt or concrete production, or as bedding sand for block pavers. Type A sand has reduced fines content which is appropriate where greater permeability (eg as bedding sand for permeable pavers) or where void space for a binding additive or control of deleterious fines is required (eg in concrete manufacture). Particle shape of sands can influence workability of manufactured products such as concrete or asphalt. Sands from natural alluvial deposits will generally have more rounded particle shape imparting better workability than those produced from crushing of rock which will have more angular particles.  Type C Sand is used as either a bedding material or as a backfill. It is typically a by-product from the production of aggregates and provides greater structural support for a road pavement than say, a fine natural sand.  Type D sand has negligible control over particle size distribution and may be a wind-blown dune sand or poorly graded alluvial sand. These sands provide relatively low structural support for a road pavement and are generally suitable as filling sands.  Asphalt Aggregate  The specified properties of asphalt aggregates focus on the soundness and durability of the rock to ensure a long term service life, particle shape as this influences workability and compaction behaviour, and polishing performance to ensure satisfactory frictional characteristics in service. The Particle size distribution of the component aggregate is not specified as this is controlled by the asphalt specification, however the variability of the nominated PSD is controlled as consistent aggregates are essential to achieving consistent asphalt properties.  Mineral Filler for Asphalt, Other than Hydrated Lime  Information on mineral filler can be found in AGPT Part 4B: Asphalt [12].  Additional Requirements for Basic Igneous Source Rock  The performance of basalts can range from suitable to unsuitable depending on the proportion of secondary minerals found in the source rock. These requirements have been adapted from the VicRoads Specifications.  Arrestor Bed Material  The purpose of arrestor bed material is to provide an uncompacted and unbound pavement which can absorb the kinetic energy of a moving vehicle and applies suitable deceleration to the vehicle entering the arrestor bed.  Historical Product Nomenclature  The “Pavement Materials” nomenclature was changed in early the early 2000’s with the ‘PM2000’ group of pavement products, as it was known at the time. The change was partly based on the introduction of recycled and performance-based road base products. The conversion between the previous pavement materials products and the current group are listed in Table 1.  **Table 1: Conversion between historical (pre PM-2000) and current nomenclature of pavement materials(1)**   |  |  |  | | --- | --- | --- | | Historical Nomenclature | Historical Description  (nominal product size only) | Closest product to current version(2) | | PM0 Series | Spalls and Ballast | Spalls and Road Ballast | | PM1 | Spalls, 300 mm | SP300 | | PM2 | Ballast, 100 mm | RB100 | | PM3 | Ballast, 65 mm | RB65 | | PM10 Series | Quarry Waste | Class 3 Quarried Pavement Material(3) | | PM11 | 20 mm Quarry Waste | - | | PM12 | 40 mm Quarry Waste | - | | PM20 Series | Quarry Rubble | Class 2 Quarried Pavement Material | | PM21 | 20 mm Quarry Rubble | PM 2/20 QG | | PM22 | 55 mm Quarry Rubble | - | | PM23 | 75 mm Quarry Rubble | - | | PM24 | 225 mm Quarry Rubble | - | | PM25 | 40 mm Quarry Rubble | PM 2/40 QG | | PM30 Series | Crushed Rock | Class 1 Quarried Pavement Material | | PM32 | 20 mm Crushed Rock | PM1/20 QG | | PM33 | 30 mm Crushed Rock | PM1/30 QG | | PM35 | 40 mm Crushed Rock | PM1/40 QG | | PM36 | 40 mm Crushed Rock | - | | PM40 Series | Screenings and Grit | Sealing Aggregate | | PM41 | 16 - 10 mm Screenings | - | | PM42 | 14 - 10 mm Screenings | SA 14-10 | | PM43 | 10 - 7 mm Screenings | SA 10-7 | | PM44 | 7 - 5 mm Screenings | SA 7-5 | | PM45 | 5 - 2 mm Grit | SA 5-2 | | PM50 Series | Aggregate | Asphalt Aggregate(4) | | PM51 | 35 - 20 mm Aggregate | - | | PM52 | 35 - 14 mm Aggregate | - | | PM53 | 20- 14 mm Aggregate | - | | PM54 | 14 - 7 mm Aggregate | - | | PM55 | 7- 2 mm Aggregate | - | | PM60 Series | Sand | Sand | | PM61 | Type A Sand | Sa – A | | PM62 | Type B Sand | Sa – B | | PM63 | Type C Sand | Sa – C | | PM64 | Type D Sand | Sa – D |   Notes:   1. This table should be used as a general guide only. Conversions are from Part R15 specifications to the Department of Transport (SA) Specifications for Supply and Delivery of Pavement Material, dated July 1994 (knet #2449277). Variations in specifications limits and tests do occur between these two specifications, and between other versions of the specifications (released on different dates). Extensions to these naming codes are described in the specifications, e.g. for plant treated materials. New products have been added since July 1994, for example ‘Class 1 heavy duty quarried pavement material, ‘SA 20-14 mm sealing aggregate’ and ‘rail ballast’. Other products have also since been removed, such as ‘225 mm quarry rubble’. 2. Recycled pavement materials can be substituted for Class 1, Class 2 and Class 3 products in accordance with Part R15, and similarly performance-based pavement materials for Class 1 and Class 2 products. 3. ‘Quarry Waste’ and ‘Class 3 Pavement Material’ have different specifications, although the intent of the products is similar. 4. Asphalt aggregate products are no longer specified, but rather specifications for size fractions and production tolerances are provided.   More background information on the development of the pavement materials nomenclature can be found in the following documents (DPTI internal document only):   * *New Standard Specifications for Pavement Materials*, 6 April 2000 (Knet #6888120). * *Pavement Materials Flow Chart* (Knet #10919763).   **ROAD BALLAST**  As a drainage layer material, the product needs to be free of fines to maximise permeability and reduce the likelihood of long term clogging. The gradation in particle sizes and angular particle shape from crushing of quarried rock assists in achieving mechanical interlock for stability. To prevent clogging of the drainage layer with fines during its service life, geotextile separation membranes should be used under and over a drainage layer.  As a macadam material, the specified properties comprise particle size distribution to assist with achieving good mechanical interlock, and Los Angeles abrasion as a measure of hardness and durability. The specified value of 45% allows the use of quartzite from Adelaide Hills quarries. This is a softer rock than dolomitic siltstones, and some breakdown at points of inter-particle contact within the layer will occur. This assists in achieving a strong particle interlock.  **RAIL BALLAST**  Rail ballast is required to [9]:   * Distribute the weight of trains from the track, through the sleepers to the ground beneath * Keep the track from moving under the weight of trains * Provide adequate drainage for the track * Maintain proper track alignment and level under dynamic loads imposed by trains and thermal stresses from environmental temperature changes * Retard vegetation growth * Reduce dust build up which may lead to uneven support to the rail   These requirements represent one of the most demanding applications for crushed aggregate.  The rail ballast specification was developed in consideration of the following documents:   * AS 2758.7 “Aggregates and Rock for Engineering Purposes, Part 7: Railway Ballast” * Australian Rail Track Corporation Ltd Ballast Specification, ETA-04-01 (weblink: https://extranet.artc.com.au/docs/eng/track-civil/procedures/ballast/eta-04-01.pdf) * Trans Adelaide's Railway Ballast Supply & Delivery Specification (March 2009) (knet #224258 – DPTI Internal Document).   The required testing rate of ‘two tests 1st per lot, one test per lot thereafter’ is a compromise between that of the ARTC Specification (one test per lot on a per project basis, with the first lot being 300 tonnes and every lot thereafter being 5000 tonnes) and the Australian Standards (min. of 3 test per lot for 1000 tonnes and 6 tests per lot for 5000 tonne lots). A testing rate of 1 test per 5000 tonnes may be too low due to the variable nature of recycled materials.  Source Materials  The performance of rail ballast as a structural material is reliant upon strong mechanical interlock between particles. River gravel comprises rounded particles with smooth surfaces which reduce inter-particle friction. Metallurgical Slag generally does not meet the hardness and strength requirements for a ballast to withstand the heavy repetitive loading from locomotives and railcars.  Particle Size Distribution  There are conflicting requirements imposed on a material specification to ensure it is both mechanically strong and free draining. The gradation limits are intended to balance these competing objectives. A range of particle sizes will produce an interlocking matrix for structural strength whilst a low fines content will ensure a permeable free draining material. Structural strength is increased by increasing the fines content to produce a maximum density grading distribution. However a maximum density grading also reduces permeability. Under the heavy repetitive loading imposed by the passage of a train, a material that is not free draining will develop pore pressure which can result in sudden loss of layer strength.  Bulk Density  This test provides the mass per unit volume of the material either in stockpile or when loaded into a bulk container for delivery. For rail ballast, the density is measured as a compacted bulk density. This provides information from which the volume of material required for a project can be determined. The test is also an indirect check on particle interlock and particle density.  Particle Density  This test measures the density of the aggregate particle obtained by measuring the displacement of water. Surface pores or permeable pores within the rock fabric become filled with water during the test. Impermeable pores within the rock matrix are not filled with water and will reduce the particle density. The minimum limit for Particle Density is to ensure that rocks with excessive impermeable pores are not used as their long term strength and durability may be reduced.  Wet/Dry Strength  The specification limits are appropriate for a Class N rail track – ie a track design to carry a loading of 1 million to 6 million tonnes per year.  Los Angeles Value  The specification limits for the Los Angeles test are based on the tonnage capacity of the track. A Class N track has a capacity of 1 – 6 million tonnes per year; A Class H track has > 6 million tonnes per year and the lower Los Angeles value reflects the increased abrasion resistance required under more frequent train movements.  Mis-shapen Particles  This test measures the proportion of Flat, Elongated or Flat and Elongated particles using a 2:1 length to width ratio. Flat and elongated particles are liable to fracture under load and will not pack as tightly together as more cubicle particles.  **CLASS 3 RECYCLED PAVEMENT MATERIAL [GRADING BASED]**  The “Grading Based” specification is a traditional recipe style specification that has been developed from a long history of pavement construction using a wide variety of materials and processes.  Class 3 materials are suitable for:   * Working platforms for moderately trafficked roads and lower sub-base layers for lightly trafficked roads. * Sheeting and shoulder material for unsealed roads, subject to approval (refer Part R15 Clause 6).   The objectives of each element of the specification are as follows:  Particle Size Distribution:  A reduced number of sieve sizes are specified compared to the higher quality Class 1 and Class 2 product specifications. This enables a wider range of production processes to be employed such as portable track mounted single stage crushing plants which are easily transported to remote sites for small scale projects. Pre and/or post primary crush scalping screens on larger multi stage crushing plants in larger well controlled recycling operations may also deliver a product that meets the specification.  The PSD is intended to deliver a moderately dense graded product from a diverse range of component materials that provides a workable product that can be readily compacted and which has moderate strength as a foundation layer for a moderately trafficked pavement or as a sheeting material for an unsealed road or pavement shoulder.  Atterberg Limits  The liquid limit of 35% permits the presence of some clay and deleterious fines components but limits their proportion consistent with the intended lower structural importance and stability demands placed on the material.  The maximum plasticity index of 15% is high for a pavement material and will mean that the material at this limit will lose strength and stability when wet. In low trafficked arid areas, cohesion may be more important than strength and such a material will be more cohesive, less prone to ravelling and have lower permeability (better water shedding properties) than a product with low plasticity. In moderate to high traffic applications, such a material will have insufficient stability and strength and is only suitable for foundation pavement layers where traffic stresses are lowest.  Foreign Materials  Type I Foreign Materials comprise metal, glass, asphalt, stone, ceramics and slag (other than blast furnace slag). No foreign material limits are placed on these components as they are generally strong, durable materials and will have no detrimental effect on a recycled product in small proportions. Separate approval procedures are applicable if such components are intended as an alternative source materials (Refer R15 Clause 6).  Type II Foreign Materials comprise plaster, clay lumps and other friable material.  Type III Foreign Materials comprise rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter.  Such materials may break down during service or contribute to a change in material properties including loss of strength, increase in moisture sensitivity, or localised weak spots if not controlled. A separate limit is placed on bitumen as this can have beneficial cohesive and moisture resistance properties.  Los Angeles Abrasion  The specification limit of 45% can be met by products containing a high proportion of reclaimed concrete, whilst still acting as a check against the incorporation of excessive proportions of softer, less durable materials such as brick and tile.  **CLASS 3 QUARRIED PAVEMENT MATERIAL [GRADING BASED]**  The “Grading Based” specification is a traditional recipe style specification that has been developed from a long history of pavement construction using a wide variety of materials and processes.  Class 3 materials are suitable for:   * + Working platforms for moderately trafficked roads and lower sub-base layers for lightly trafficked roads.   + Sheeting and shoulder material for unsealed roads.   The objectives of each element of the specification are as follows.  Particle Size Distribution  A reduced number of sieve sizes are specified compared to the higher quality Class 1 and Class 2 product specifications. This enables a wider range of production processes to be employed such as portable track mounted single stage crushing plants which are easily transported to remote borrow pits for small scale projects. Pre and/or post primary crush scalping screens on larger multi stage crushing plants in larger well controlled crushing operations may also deliver a product that meets this specification.  The PSD is intended to deliver a moderately dense graded product from a diverse range of locally available borrow pit rock sources and to provide a workable product that can be readily compacted and which has moderate strength as a foundation layer for a moderately trafficked pavement or as a sheeting material for an unsealed road or pavement shoulder.  Atterberg Limits  The liquid limit of 35% permits the presence of some clay and deleterious fines components but limits their proportion consistent with the intended lower structural importance and stability demands placed on the material.  The maximum plasticity index of 15% is high for a pavement material and will mean that the material at this limit will lose strength and stability when wet. In low trafficked arid areas, cohesion may be more important than strength and such a material will be more cohesive, less prone to ravelling and have lower permeability (better water shedding properties) than a product with low plasticity. In moderate to high traffic applications, such a material will have insufficient stability and strength and is only suitable for foundation pavement layers where traffic stresses are lowest.  Los Angeles Abrasion  The specification limit of 45% can be met by softer rocks such as calcretes or quartzites typically available across South Australia in local borrow pits.  **CLASS 2 RECYCLED PAVEMENT MATERIAL [GRADING BASED]**  The “Grading Based” specification is a traditional recipe style specification that has been developed from a long history of pavement construction using a wide variety of materials and processes.  Class 2 materials are suitable for:   * Upper sub-base, lower sub-base, and working platforms for heavily and moderately trafficked roads and base for lightly trafficked roads. * Sheeting and shoulder material for unsealed roads, subject to approval (refer Part R15 Clause 6). * Feed for cement treated pugmill mixed bound products subject to approval (Refer R15 Clause 8 under “Recycled Products”).   The objectives of each element of the specification are as follows;  Particle Size Distribution  A full suite of sieve sizes are specified to achieve close to a maximum density distribution of particle sizes and a workable product that can be readily compacted and which has adequate strength as a subbase on heavily trafficked roads or as a basecourse on lightly trafficked roads. Primary and secondary crushing stages will typically be required to achieve the specification.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 2 products, no limits are placed on the grading distribution crossing from the coarse side of the grading envelope to the fine side or vice versa. Such an outcome can occur as a result of crusher settings, or as a result of the particle size composition of the rock. For example concrete is produced from blending aggregate, sand and cement. Reclaimed concrete will naturally crush back to these component materials depending on the strength of the concrete and cement mortar to produce an excess of sand sized particles. An excess of one particle size is offset by a deficiency in another size and can result in the grading distribution crossing the envelope. Such an outcome is undesirable as it will adversely impact on permeability, workability and strength of the product in a pavement layer. This limits the use of Class 2 materials to lower stress applications.  Atterberg Limits  The liquid limit of 28% provides tighter control over the presence of clay and deleterious fines components than for a Class 3 product and limits their proportion consistent with the intended lower structural importance and stability demands placed on the material.  The maximum plasticity index of 8% is acceptable for a subbase pavement material where trafficked induced stresses are reduced and loss of strength and stability when wet will not be sufficiently high as to adversely affect pavement performance.  When used as a sheeting material for an unsealed road or pavement shoulder, the product should have a plasticity in the mid to high end of the specification range. In low trafficked and arid areas, cohesion may be more important than strength and such a material will be more cohesive, less prone to ravelling and have lower permeability (better water shedding properties) than a product with low plasticity.  For pugmill mixed, cement stabilised materials, the limits on plasticity serve to limit the proportion of clay present in the material. Excessive clay may reduce the strength of the stabilised material.  Foreign Materials  Type I Foreign Materials comprise metal, glass, asphalt, stone, ceramics and slag (other than blast furnace slag). No foreign material limits are placed on these components as they are generally strong, durable materials and will have no detrimental effect on a recycled product in small proportions. Separate approval procedures are applicable if such components are intended as an alternative source materials (Refer R15 Clause 6).  Type II Foreign Materials comprise plaster, clay lumps and other friable material.  Type III Foreign Materials comprise rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter.  Such materials may break down during service or contribute to a change in material properties including loss of strength, increase in moisture sensitivity, or localised weak spots if not controlled. A separate limit is placed on bitumen as this can have beneficial cohesive and moisture resistance properties.  Los Angeles Abrasion  The specification limit of 45% can be met by products containing a high proportion of reclaimed concrete, whilst still acting as a check against the incorporation of excessive proportions of softer, less durable materials such as brick and tile.  **CLASS 2 RECYCLED PAVEMENT MATERIAL [PERFORMANCE BASED]**  Class 2 recycled, performance based materials are suitable for:   * Upper sub-base, lower sub-base, and working platforms for heavily and moderately trafficked roads and base for lightly trafficked roads. * Sheeting and shoulder material for unsealed roads, subject to approval (refer Part R15 Clause 6). * Feed for cement treated pugmill mixed bound products subject to approval (Refer R15 Clause 8 under “Recycled Products”).   The “Performance Based” specification was developed from research undertaken by South Australia during the 1990’s. The drivers for the research included:   * The utilisation of recycled (construction and demolition) materials and industrial by-products to meet community expectations related to environmental sustainability and reduction in waste management costs. * The most efficient use of increasingly scarce high quality materials. There is a need for ‘fit for purpose’ materials so that the highest quality materials are only used where they are needed. * The increase in heavy vehicle loading (increasing axle number, gross mass and tyre pressure and the introduction of new generation vehicles which are placing higher stresses on granular materials.   Particle Size Distribution  A reduced number of sieve sizes and a wider envelope are specified compared to the Grading Based product specifications because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests. This enables a wider range of production processes to be employed or alternative source materials to be utilised that may not meet traditional specification criteria.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 2 products, no limits are placed on the grading distribution crossing from the coarse side of the grading envelope to the fine side or vice versa. Such an outcome can occur as a result of crusher settings, or as a result of the particle size composition of the rock. For example concrete is produced from blending aggregate, sand and cement. Reclaimed concrete will naturally crush back to these component materials depending on the strength of the concrete and cement mortar to produce an excess of sand sized particles. An excess of one particle size is offset by a deficiency in another size and can result in the grading distribution crossing the envelope. Such an outcome is undesirable as it will adversely impact on permeability, workability and strength of the product in a pavement layer. This limits the use of Class 2 materials to lower stress applications.  Atterberg Limits  The liquid limit of 30% and maximum plasticity index of 10% are slight relaxations on the limits for Class 2 Grading Based materials because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests.  When used as a sheeting material for an unsealed road or pavement shoulder, the product should have a plasticity in the mid to high end of the specification range. In low trafficked and arid areas, cohesion may be more important than strength and such a material will be more cohesive, less prone to ravelling and have lower permeability (better water shedding properties) than a product with low plasticity.  For pugmill mixed, cement stabilised materials, the limits on liquid limit and plasticity serve to limit the proportion of clay present in the material. Excessive clay may reduce the strength of the stabilised material.  Performance Tests (Resilient Modulus, Deformation and Triaxial Compression)  The specification limits for these properties are a result of the research undertaken during the 1990’s by South Australia on a wide range of quarry products available in the state. This work is documented in the MT16 series of research reports (DPTI internal documents).  Los Angeles Abrasion  Arising from implementation of the performance based specification, products have been identified that meet the specification requirements except for Los Angeles Value. I.e. they are soft rocks that nevertheless exhibit the required workability, strength and performance properties required from a Class 2 crushed rock. These sources tend to be high in calcium carbonate and show no tendency to weather or degrade in service to clays. Accordingly a “Contractor Nominated Value” has been incorporated into the specification to allow for these materials. Nevertheless, as part of the assessment process for new innovative recycled materials, consideration needs to be given to the potential of the source material to weather or degrade over time before it is approved for use.  Foreign Materials  Type I Foreign Materials comprise metal, glass, asphalt, stone, ceramics and slag (other than blast furnace slag). No foreign material limits are placed on these components as they are generally strong, durable materials and will have no detrimental effect on a recycled product in small proportions. Separate approval procedures are applicable if such components are intended as an alternative source materials (Refer R15 Clauses 6).  Type II Foreign Materials comprise plaster, clay lumps and other friable material.  Type III Foreign Materials comprise rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter.  Such materials may break down during service or contribute to a change in material properties including loss of strength, increase in moisture sensitivity, or localised weak spots if not controlled. A separate limit is placed on bitumen as this can have beneficial cohesive and moisture resistance properties.  Manufacturing Tolerances  Manufacturing tolerances are applied to the material suppliers nominated mix properties. This is to ensure that materials supplied to a project are consistent in quality and the properties are equivalent to the sample on which the performance based tests were undertaken and approved for production.  The tolerances in the specification were obtained from statistical analysis of production from several rural crushing contracts managed by DPTI during the 1990s. The tolerance represents twice the standard deviation around the mean for the particular property measured. Accordingly, for a well-controlled crushing operation, conformance with the specification should be achieved for 95% of Lots produced.  **CLASS 2 QUARRIED PAVEMENT MATERIAL [GRADING BASED]**  The “Grading Based” specification is a traditional recipe style specification that has been developed from a long history of pavement construction using a wide variety of materials and processes.  Class 2 materials are suitable for:   * Upper sub-base, lower sub-base, and working platforms for heavily and moderately trafficked roads and base for lightly trafficked roads. * Sheeting and shoulder material for unsealed roads. * Feed for cement treated pugmill mixed bound products.   The objectives of each element of the specification are as follows;  Particle Size Distribution:  A full suite of sieve sizes are specified to achieve close to a maximum density distribution of particle sizes and a workable product that can be readily compacted and which has adequate strength as a subbase on heavily trafficked roads or as a basecourse on lightly trafficked roads. Primary and secondary crushing stages will typically be required to achieve the specification.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 2 products, no limits are placed on the grading distribution crossing from the coarse side of the grading envelope to the fine side or vice versa. Such an outcome can occur as a result of crusher settings, or as a result of the particle size composition of the rock. For example quartzites or dolomitic siltstones are comprised of sand or silt sized particles and will naturally crush to produce an excess of sand or silt sized particles. An excess of one particle size is offset by a deficiency in another size and can result in the grading distribution crossing the envelope. Such an outcome is undesirable as it will adversely impact on permeability, workability and strength of the product in a pavement layer. This limits the use of Class 2 materials to lower stress applications.  Atterberg Limits  The liquid limit of 28% provides tighter control over the presence of clay and deleterious fines components than for a Class 3 product and limits their proportion consistent with the intended lower structural importance and stability demands placed on the material.  The maximum plasticity index of 8% is acceptable for a subbase pavement material where trafficked induced stresses are reduced and loss of strength and stability when wet will not be sufficiently high as to adversely affect pavement performance.  When used as a sheeting material for an unsealed road or pavement shoulder, the product should have a plasticity in the mid to high end of the specification range. In low trafficked and arid areas, cohesion may be more important than strength and such a material will be more cohesive, less prone to ravelling and have lower permeability (better water shedding properties) than a product with low plasticity.  For pugmill mixed, cement stabilised materials, the limits on plasticity serve to limit the proportion of clay present in the material. Excessive clay may reduce the strength of the stabilised material.  Los Angeles Abrasion  The specification limit of 45% can be met by softer rocks such as calcretes or quartzites typically available across South Australia in local borrow pits.  **CLASS 2 QUARRIED PAVEMENT MATERIAL [PERFORMANCE BASED]**  Class 2 quarried, performance based materials are suitable for:   * Upper sub-base, lower sub-base, and working platforms for heavily and moderately trafficked roads and base for lightly trafficked roads. * Sheeting and shoulder material for unsealed roads. * Feed for cement treated pugmill mixed bound products.   The “Performance Based” specification was developed from research undertaken by South Australia during the 1990’s. The drivers for the research included:   * The utilisation of recycled (construction and demolition) materials and industrial by-products to meet community expectations related to environmental sustainability and reduction in waste management costs * The most efficient use of increasingly scarce high quality materials. There is a need for ‘fit for purpose’ materials so that the highest quality materials are only used where they are needed. * The increase in heavy vehicle loading (increasing axle number, gross mass and tyre pressure and the introduction of new generation vehicles which are placing higher stresses on granular materials.   [See also: Part R15 Commentary Clause 7 “Performance Based Pavement Materials”]  Particle Size Distribution  A reduced number of sieve sizes and a wider envelope are specified compared to the Grading Based product specifications because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests. This enables a wider range of production processes to be employed or alternative source materials to be utilised that may not meet traditional specification criteria.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 2 products, no limits are placed on the grading distribution crossing from the coarse side of the grading envelope to the fine side or vice versa. Such an outcome can occur as a result of crusher settings, or as a result of the particle size composition of the rock. For example concrete is produced from blending aggregate, sand and cement. Reclaimed concrete will naturally crush back to these component materials depending on the strength of the concrete and cement mortar to produce an excess of sand sized particles. An excess of one particle size is offset by a deficiency in another size and can result in the grading distribution crossing the envelope. Such an outcome is undesirable as it will adversely impact on permeability, workability and strength of the product in a pavement layer. This limits the use of Class 2 materials to lower stress applications.  Atterberg Limits  The liquid limit of 30% and maximum plasticity index of 10% are slight relaxations on the limits for Class 2 Grading Based materials because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests.  When used as a sheeting material for an unsealed road or pavement shoulder, the product should have a plasticity in the mid to high end of the specification range. In low trafficked and arid areas, cohesion may be more important than strength and such a material will be more cohesive, less prone to ravelling and have lower permeability (better water shedding properties) than a product with low plasticity.  For pugmill mixed, cement stabilised materials, the limits on liquid limit and plasticity serve to limit the proportion of clay present in the material. Excessive clay may reduce the strength of the stabilised material.  Performance Tests (Resilient Modulus, Deformation and Triaxial Compression)  The specification limits for these properties are a result of the research undertaken during the 1990’s by South Australia on a wide range of quarry products available in the state. This work is documented in the MT16 series of research reports (DPTI internal documents). The lower limits for modulus, deformation, cohesion and friction angle compared to Class 1 products, reflect the lower structural demands placed on Class 2 materials.  Los Angeles Abrasion  Arising from implementation of the performance based specification, products have been identified that meet the specification requirements except for Los Angeles Value. I.e. they are soft rocks that nevertheless exhibit the required workability, strength and performance properties required from a Class 2 crushed rock. These sources tend to be high in calcium carbonate and show no tendency to weather or degrade in service to clays. Accordingly a “Contractor Nominated Value” has been incorporated into the specification to allow for these materials. Nevertheless, as part of the assessment process for new materials, consideration needs to be given to the potential of the source material to weather or degrade over time before it is approved for use.  Manufacturing Tolerances  Manufacturing tolerances are applied to the material suppliers nominated mix properties. This is to ensure that materials supplied to a project are consistent in quality and the properties are equivalent to the sample on which the performance based tests were undertaken and approved for production.  The tolerances in the specification were obtained from statistical analysis of production from several rural crushing contracts managed by DPTI during the 1990s. The tolerance represents twice the standard deviation around the mean for the particular property measured. Accordingly, for a well-controlled crushing operation, conformance with the specification should be achieved for 95% of Lots produced.  **CLASS 1 RECYCLED PAVEMENT MATERIAL [GRADING BASED]**  The “Grading Based” specification is a traditional recipe style specification that has been developed from a long history of pavement construction using a wide variety of materials and processes.  Class 1 materials are suitable for:   * Base layer(s). * Feed for cement treated pugmill mixed bound products subject to approval (Refer R15 Clause 8 under “Recycled Products”).   The objectives of each element of the specification are as follows:  Particle Size Distribution  A full suite of sieve sizes are specified to achieve close to a maximum density distribution of particle sizes and a workable product that can be readily compacted and which has adequate strength as a sealed base on moderately trafficked roads. Primary, secondary and tertiary crushing stages will typically be required to achieve the specification.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 1 products, the grading distribution cannot cross from the coarse side of the grading envelope to the fine side or vice versa. Such an outcome can occur as a result of crusher settings, or as a result of the particle size composition of the rock. For example concrete is produced from blending aggregate, sand and cement. Reclaimed concrete will naturally crush back to these component materials, depending on the strength of the concrete and cement mortar, to produce an excess of sand sized particles. An excess of one particle size is offset by a deficiency in another size and can result in the grading distribution crossing the envelope. Such an outcome is undesirable as it will adversely impact on permeability, workability and strength of the product as a basecourse pavement layer.  Atterberg Limits  The liquid limit of 25% provides tighter control over the presence of clay and deleterious fines components than for a Class 2 product and limits their proportion consistent with the intended higher structural importance and stability demands placed on the material as a basecourse.  The maximum plasticity index of 6% is required to minimise the risk of loss of strength and stability under heavy vehicle wheel loadings when wet. A minimum plasticity of 1% is required to ensure that the material is workable and compactable during construction, and has some cohesion to resist ravelling under short term trafficking prior to sealing.  For pugmill mixed, cement stabilised materials, the limits on plasticity serve to limit the proportion of clay or deleterious components present in the material. Excessive clay may reduce the strength of the stabilised material.  Foreign Materials  Type I Foreign Materials comprise metal, glass, asphalt, stone, ceramics and slag (other than blast furnace slag). No foreign material limits are placed on these components as they are generally strong, durable materials and will have no detrimental effect on a recycled product in small proportions. Separate approval procedures are applicable if such components are intended as an alternative source materials (Refer R15 Clause 6).  Type II Foreign Materials comprise plaster, clay lumps and other friable material.  Type III Foreign Materials comprise rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter.  Such materials may break down during service or contribute to a change in material properties including loss of strength, increase in moisture sensitivity, or localised weak spots if not controlled. A separate limit is placed on bitumen as this can have beneficial cohesive and moisture resistance properties.  Los Angeles Abrasion  The specification limit of 30% will require source concrete to be of structural grade such as from the demolition of bridges, buildings or high quality concrete pavements. Appropriate stockpile management will be required to separate high quality demolition concrete from general purpose concrete (footpaths, kerbing etc) in order to meet this requirement.  **CLASS 1 RECYCLED PAVEMENT MATERIAL [PERFORMANCE BASED]**  Class 1 recycled, performance based materials are suitable for:   * Base layer(s). * Feed for cement treated pugmill mixed bound products subject to approval (Refer R15 Clause 8 under “Recycled Products”).   The “Performance Based” specification was developed from research undertaken by South Australia during the 1990’s. The drivers for the research included:   * The utilisation of recycled (construction and demolition) materials and industrial by-products to meet community expectations related to environmental sustainability and reduction in waste management costs. * The most efficient use of increasingly scarce high quality materials. There is a need for ‘fit for purpose’ materials so that the highest quality materials are only used where they are needed. * The increase in heavy vehicle loading (increasing axle number, gross mass and tyre pressure and the introduction of new generation vehicles which are placing higher stresses on granular materials.   Particle Size Distribution:  A reduced number of sieve sizes and a wider envelope are specified compared to the Grading Based product specifications because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests. This enables a wider range of production processes to be employed or alternative source materials to be utilised that may not meet traditional specification criteria.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 1 performance based products, no limits are placed on the grading distribution crossing from the coarse side of the grading envelope to the fine side or vice versa because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests.  Atterberg Limits  The liquid limit of 25% and maximum plasticity index of 6% are the same as for Class 1 Grading Based materials to guard against loss of shear strength when wet.  For pugmill mixed, cement stabilised materials, the limits on liquid limit and plasticity serve to limit the proportion of clay present in the material. Excessive clay may reduce the strength of the stabilised material.  Performance Tests (Resilient Modulus, deformation and Triaxial Compression)  The specification limits for these properties are a result of the research undertaken during the 1990’s by South Australia on a wide range of quarry products available in the state. This work is documented in the MT16 series of research reports. The tighter limits for modulus, deformation, cohesion and friction angle compared to Class 2 products, reflect the higher structural demands placed on Class 1 materials  Los Angeles Abrasion  Arising from implementation of the performance based specification, products have been identified that meet the specification requirements except for Los Angeles Value. I.e. they are soft rocks that nevertheless exhibit the required workability, strength and performance properties required from a Class 2 crushed rock. These sources tend to be high in calcium carbonate and show no tendency to weather or degrade in service to clays. Accordingly a “Contractor Nominated Value” has been incorporated into the specification to allow for these materials. Nevertheless, as part of the assessment process for new innovative recycled materials, consideration needs to be given to the potential of the source material to weather or degrade over time before it is approved for use.  Foreign Materials  Type I Foreign Materials comprise metal, glass, asphalt, stone, ceramics and slag (other than blast furnace slag). No foreign material limits are placed on these components as they are generally strong, durable materials and will have no detrimental effect on a recycled product in small proportions. Separate approval procedures are applicable if such components are intended as an alternative source materials (Refer R15 Clauses 6).  Type II Foreign Materials comprise plaster, clay lumps and other friable material.  Type III Foreign Materials comprise rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter.  Such materials may break down during service or contribute to a change in material properties including loss of strength, increase in moisture sensitivity, or localised weak spots if not controlled. A separate limit is placed on bitumen as this can have beneficial cohesive and moisture resistance properties.  Manufacturing Tolerances  Manufacturing tolerances are applied to the material suppliers nominated mix properties. This is to ensure that materials supplied to a project are consistent in quality and the properties are equivalent to the sample on which the performance based tests were undertaken and approved for production.  The tolerances in the specification were obtained from statistical analysis of production from several rural crushing contracts managed by DPTI during the 1990s. The tolerance represents twice the standard deviation around the mean for the particular property measured. Accordingly, for a well-controlled crushing operation, conformance with the specification should be achieved for 95% of Lots produced.  **CLASS 1 QUARRIED PAVEMENT MATERIAL [GRADING BASED]**  Class 1 materials are suitable for:   * Base layer(s). * Feed for cement treated pugmill mixed bound products.   The “Grading Based” specification is a traditional recipe style specification that has been developed from a long history of pavement construction using a wide variety of materials and processes.  The objectives of each element of the specification are as follows:  Particle Size Distribution  A full suite of sieve sizes are specified to achieve close to a maximum density distribution of particle sizes and a workable product that can be readily compacted and which has adequate strength as a sealed base on moderately trafficked roads. Primary, secondary and tertiary crushing stages will typically be required to achieve the specification.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 1 products, the grading distribution cannot cross from the coarse limit of the grading envelope to the fine limit or vice versa. Such an outcome can occur as a result of crusher settings, or as a result of the particle size composition of the rock. For example dolomitic siltstones are comprised of silt sized particles and will naturally crush to produce an excess of silt sized particles. An excess of one particle size is offset by a deficiency in another size and can result in the grading distribution crossing the envelope. Such an outcome is undesirable as it will adversely impact on permeability, workability and strength of the product in a pavement layer.  Excess silty fines is an issue for dolomitic siltstone products and ratio of 0.425 mm to 0.075 mm. ‘Earlier versions of Specifications for crushed rock [Class 1 pavement material], particularly in calcareous materials, required that the percentage of product finer that 75 microns was less than half the percentage of product finer that 425 microns.’ [1] Sites with dolomitic siltstone may need to consider this as an extra requirement. Refer to the Material/Quality notes of the Fords (Light Crushing Contract) Quarry site [1].  Removal of this requirement was a pragmatic response to the difficulties many quarries faced in meeting the ratio. Particularly with dolomitic siltstones, during crushing the rock naturally generated a relatively high proportion of silt sized particles as this was the geological building material for the rock. Crushing of calcretes frequently resulted in excess 0.0425 mm material and a deficiency in 0.075 mm material for similar reasons. Despite this crews learnt how to handle the materials and they served well as basecourse. The wording of the note was also vague (coarse side to fine side) and difficult to interpret and so was amended to state that it could not move from the coarse “limit” to the fine “limit”.  Atterberg Limits  The liquid limit of 25% provides tighter control over the presence of clay and deleterious fines components than for a Class 2 product and limits their proportion consistent with the intended higher structural importance and stability demands placed on the material as a basecourse.  The maximum plasticity index of 6% is required to minimise the risk of loss of strength and stability under heavy vehicle wheel loadings when wet. A minimum plasticity of 1% is required to ensure that the material is workable and compactable during construction, and has some cohesion to resist ravelling under short term trafficking prior to sealing.  For pugmill mixed, cement stabilised materials, the limits on plasticity serve to limit the proportion of clay or deleterious components present in the material. Excessive clay may reduce the strength of the stabilised material.  Los Angeles Abrasion  The specification limit of 30% can generally be met by dolomitic siltstone, limestone and hard igneous quarries, but not generally by quartzite or calcrete deposit. Better quality calcretes can be processed using pre and post primary scalping and with tertiary crushing to remove or breakdown softer components to achieve this limit.  **CLASS 1 QUARRIED PAVEMENT MATERIAL [PERFORMANCE BASED]**  Class 1 quarried, performance based materials are suitable for:   * Base layer(s). * Feed for cement treated pugmill mixed bound products.   The “Performance Based” specification was developed from research undertaken by South Australia during the 1990’s. The drivers for the research included:   * The utilisation of recycled (construction and demolition) materials and industrial by-products to meet community expectations related to environmental sustainability and reduction in waste management costs. * The most efficient use of increasingly scarce high quality materials. There is a need for ‘fit for purpose’ materials so that the highest quality materials are only used where they are needed. * The increase in heavy vehicle loading (increasing axle number, gross mass and tyre pressure and the introduction of new generation vehicles which are placing higher stresses on granular materials.   [See also: Part R15 Commentary Clause 7 “Performance Based Pavement Materials”]  Particle Size Distribution:  A reduced number of sieve sizes and a wider envelope are specified compared to the Grading Based product specifications because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests. This enables a wider range of production processes to be employed or alternative source materials to be utilised that may not meet traditional specification criteria.  The coarse side of the PSD is limited by permeability and workability constraints. A coarse graded product will be more permeable, more difficult to spread and compact and with a greater tendency towards segregation. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  For Class 1 performance based products, no limits are placed on the grading distribution crossing from the coarse side of the grading envelope to the fine side or vice versa because of the additional controls on strength, deformation, cohesion and friction angle provided by the performance tests.  Atterberg Limits  The liquid limit of 25% and maximum plasticity index of 6% are the same as for Class 1 Grading Based materials to guard against loss of shear strength when wet.  For pugmill mixed, cement stabilised materials, the limits on liquid limit and plasticity serve to limit the proportion of clay present in the material. Excessive clay may reduce the strength of the stabilised material.  Performance Tests (Resilient Modulus, Deformation and Triaxial Compression)  The specification limits for these properties are a result of the research undertaken during the 1990’s by South Australia on a wide range of quarry products available in the state. This work is documented in the MT16 series of research reports (DPTI internal documents). The tighter limits for modulus, deformation, cohesion and friction angle compared to Class 2 products, reflect the higher structural demands placed on Class 1 materials.  Los Angeles Abrasion  Arising from implementation of the performance based specification, products have been identified that meet the specification requirements except for Los Angeles Value. ie they are soft rocks that nevertheless exhibit the required workability, strength and performance properties required from a Class 1 crushed rock. These sources tend to be high in calcium carbonate and show no tendency to weather or degrade in service to clays. Accordingly a “Contractor Nominated Value” has been incorporated into the specification to allow for these materials. Nevertheless, as part of the assessment process for new materials, consideration needs to be given to the potential of the source material to weather or degrade over time before it is approved for use.  Manufacturing Tolerances  Manufacturing tolerances are applied to the material suppliers nominated mix properties. This is to ensure that materials supplied to a project are consistent in quality and the properties are equivalent to the sample on which the performance based tests were undertaken and approved for production.  The tolerances in the specification were obtained from statistical analysis of production from several rural crushing contracts managed by DPTI during the 1990s. The tolerance represents twice the standard deviation around the mean for the particular property measured. Accordingly, for a well-controlled crushing operation, conformance with the specification should be achieved for 95% of Lots produced.  **CLASS 1 HEAVY DUTY QUARRIED PAVEMENT MATERIAL**  **[GRADING BASED]**  The Class 1A and 1B heavy duty materials are higher standard quarried road base materials compared to the other Class 1 products available, and were developed from Vicroads’ experience for the construction of very heavily trafficked unbound granular pavements with thin surfacings. ‘They provide improved stability and workability and are compacted to 100% Modified Maximum Dry Density and dried back to no greater than 60% Optimum Moisture Content, and are placed in layers not exceeding 125 mm thickness. However, as their availability is limited, project specific assessment is required.’ [5]  The specification includes additional controls over and above those for a Class 1 Grading Based pavement material.  The objectives of each element of the specification are as follows:  Particle Size Distribution  A full suite of sieve sizes and a slightly tighter envelope are specified. In addition, a “Percent Retained” criteria is included to ensure a uniform distribution of particle sizes to achieve close to a maximum density distribution for maximum strength outcomes. Primary, secondary and tertiary crushing stages will typically be required to achieve the specification. A rock source that has no tendency to produce an excesss of a particular size particle will also be required. Alternatively, blending of coarse and fine aggregates with carefully controlled properties and in carefully controlled proportions is an option.  The coarse side of the PSD is limited by permeability and workability constraints. Additional fines are specified relative to a Class 1 product to reduce permeability and improve workability. The fine side of the PSD envelope is limited by strength constraints. An excessively fine material will be easier to spread and compact, but will have reduced structural capacity.  Within the “Heavy Duty” classification, two specifications are provided. Class 1A is intended for harder rock types (as measured by Los Angeles Value) which are more resistant to crushing and particle breakdown during construction spreading and compaction procedures. Additional fines must therefore be generated by tertiary crushers during the material production process. Class 1B applies to softer rock types which will generate more fines during the placement and compaction processes involved in construction of the pavement.  Atterberg Limits  The liquid limit of 25% provides tight control over the presence of clay and deleterious fines and limits their proportion consistent with the intended high structural importance and stability demands placed on the material as a basecourse in a heavily trafficked road pavement.  The maximum plasticity index of 6% is required to minimise the risk of loss of strength and stability under heavy vehicle wheel loadings when wet. A minimum plasticity of 2% is required to ensure that the material is workable and compactable during construction, has some cohesion to resist ravelling under short term trafficking prior to sealing, and has a small clay component to reduce permeability in service. This plasticity requirement is very tight and a target of 4% is required to allow for variability in laboratory testing procedures.  Los Angeles Abrasion  The specification limit of 25% for the Class 1A category will be met by harder igneous rock deposits and will require the generation of additional fines through tertiary crushing during production.  The specification limit of 25% - 30% for Class 1B products can generally be met by dolomitic and limestone quarries, but not generally by quartzite or calcrete deposit which will be too soft.  Better quality calcretes, which are processed using pre and post primary scalping stages and with tertiary crushing to remove or breakdown softer components may achieve the limits for Class 1A or Class 1B.  **STABILISED PAVEMENT MATERIAL [BINDER CONTROL]**  The use of stabilised recycled material is subject to approval. Recycled material will require specific investigation and testing to verify compatibility of the binder, strength and sensitivity to binder control. [2]    This Specification details various types of plant-mixed stabilised materials produced by the addition of cement, fly ash, lime, bitumen  or combinations of binders to granular material. As cemented materials need to include cementitious binding agents in sufficient amounts to produce a bound layer with significant tensile strength, not all Part R15 stabilised materials meet this definition. The Part R15 materials described in Clause 8 of Part R15 are those DPTI consider to be cemented materials. The source material may be natural quarried material or, where approved, recycled materials complying with Part R15. In addition, stabilised material may be specified by either binder content or strength. [5]  Finely graded gravels, clayey gravels, silty sands (>50% passing 0.425 mm sieve) and other materials which do not achieve significant particle interlock are not included in the definition of cemented materials as their fatigue performance would be variable and unpredictable. [5]  **SEALING AGGREGATE**  Particle Size Distribution  Some considerations for surfacing aggregate grading are as follows [1]:   * ‘Ideally the aggregate should be of a single size (i.e. falling between adjacent sieves of a √2 series[[1]](#footnote-1)) which allows for a single layer of stone to be evenly spread on the road surface with the bitumen binder. * Small allowances are made for the efficiency of the sizing process and limited amounts of undersize and oversize particles are acceptable in the product. Surfacing aggregates are commonly referred to by the upper size limit (e.g. a 14 mm – 10 mm aggregate is referred to as ’14 mm’.’   16mm nominal size sealing aggregate (SA16-10) was incorporated into this Specification to allow for higher bitumen spray rates through a larger stone size, resulting in improved resistance to higher traffic loads and increased seal longevity. Until its inception, SA14-10 (14mm) aggregate was used for heavily trafficked pavements. The Particle Size Distribution of SA 16-10 was changed in 2010 due to a lack of distinction at the time between SA 16-10 and SA 14-10. For more information, see knet #4901284 – DPTI internal document only.  Blending of Sealing Aggregates  A material is blended if two or more materials (from the same or difference sources) are combined to make a single product. Blending may be sought for several reasons. For example, if there is a non-complying product, this product could possibly be blended with a product from that quarry or another quarry to create a complying product. If blending of sealing aggregates is used, the following general principles apply:   1. **Approval**. Blending of material should be considered on a case-by-case basis. 2. **Testing.** Testing must be undertaken on the individual source materials, as well as the blended product, to demonstrate compliance of the blended product. It will need to be shown how the results are representative of the blended product. For example, producing an average LA from stone with different properties, and selection of particles to create tiles for a PAFV test. 3. **Colour**. The source materials may be noticeably different colours. With some wear, a mottling effect may develop. Colour difference in the source rocks is only an issue for aesthetics and is at the discretion of the Principal.   Aggregates for slurry should meet the same specification requirements as asphalt aggregates (Reference Vicroads Technical Note 84 [13], Qld Transport & Main Roads Specification MRTS13 [14] and Austroads AP-T26 [15]).  Particle Shape (Flakiness, % Flat Particles)  Limits are placed on the proportion of flat or flaky particles as these particles are less able to form a tightly packed matrix in a seal, are susceptible to fracture and reduce the effective Average Least Dimension of the aggregate. As a result, determining the correct application of binder to hold the aggregate and to achieve adequate texture depth is more difficult and the seal is more vulnerable to stripping or bleeding. The production process for aggregates tends to produce a higher proportion of flaky particles in the finer size fractions, hence the higher limit for SA 7-5. The specified values have been in place for many years and provide acceptable performance. Test apparatus is not available for SA 5-2. As SA 5-2 aggregate is generally used as a locking coat over a coarser seal, the texture of the underlying seal has more significance in determining the bitumen application rate than the particle shape of the fine aggregate.  Los Angeles Value  Aggregates must be able to withstand abrasion and crushing under traffic particularly during the first few days after sealing during which time the aggregate is worked by traffic to create a single layer matrix of particles. Note, the lower the value, the harder the material. This requires a relatively hard aggregate. The specified values of 25% for coarser aggregates and 30% for finer aggregates have proven suitable over many years of experience. The higher Los Angeles Value for the finer aggregates reflects the fact that finer aggregates have a higher proportion of small and flaky particles that are more readily crushed to finer than 1.70 mm during the testing. SA 5-2 is too fine to test. Testing of SA 7-5 or SA 10-7 produced concurrently with the production of SA 5-2 is recommended.  PAFV  The requirement for resistance to polishing of sealing aggregates is dependent on several factors.   * Traffic volume and speed * Road alignment * Rainfall * Aggregate hardness and chemistry   Friction between the tyre and the road surface is influenced by the sharp asperities presented to the tyre by randomly oriented crushed aggregate particles in a spray seal. This is known as macro-texture. Micro texture is a measure of the surface roughness of an aggregate particle and is more significant in determining the frictional characteristics of an asphalt wearing course in which the aggregate particles lie flat to the surface. As a result, aggregates with lower PAFV can be successfully used in spray sealed rural roads. This is particularly so in low rainfall flat to undulating country that extends over much of rural South Australia. Traffic loading is also significant as this influences the rate of wear and hence risk of polishing that may occur. As the coarsest aggregates are usually applicable to the most heavily trafficked locations, a higher minimum PAFV is specified for SA20-14. In higher rainfall areas such as the Adelaide Hills where the road alignment is windy with sharp curves and steep grades, high PAFV aggregate is required.  The specified values for PAFV are intended to reflect the diversity of geography, traffic volumes and available aggregate sources to ensure that aggregates selected for specific sites are fit for their intended purpose.  Aggregate Stripping  The specified limits apply to aggregates that have been subjected to a laboratory design process to determine the optimum combination of precoat and adhesion agent required to meet specification. Implementation of the laboratory design recommendations is then required during construction. Nevertheless, a successful sealing outcome is reliant upon good weather during sealing and in the first few days after sealing during which time aggregate is being reoriented in the seal and adhesion with the binder is developing. Use of recommended precoat and adhesion agent provides a degree of insurance against a stripping failure arising from unexpected rain or cold weather events but does not eliminate this risk.  ALD  The Average Least Dimension of an aggregate is required for correct design of the bitumen application rate for the seal.  **SAND**  Particle Size Distribution  Depending upon the application of the sand key aspects of the PSD for the various types of sand are:   * Proportion of each size: For sands used in concrete or asphalt manufacture an even distribution of particle sizes is required to achieve a maximum density grading when blended with coarse aggregates to achieve strength or stability outcomes. For sands used as structural backfill around pipes or as a foundation layer for a pavement, a well graded sand will provide greater stability than a single size or poorly graded sand. * Void space: The design of an asphalt or concrete mix may require space within the aggregate matrix for bitumen or cement binder. Removal of 0.075 mm fines by washing may assist with this design aspect.   Atterberg Limits  The liquid limit of 25% provides tight control over the presence of clay and deleterious fines components which may be harmful to the production of high quality asphalt or concrete.  The maximum plasticity index of 6% minimises the risk of loss of strength and stability when wet for a sand used as a structural backfill or foundation layer.  For sands used as component in manufactured materials such as concrete or asphalt, use of non-plastic sand minimises any harmful effects on the strength of the manufactured product arising from the incorporation of clays.  Organic Impurities  The presence of Organic Impuritiescan have adverse consequenceson the strength of manufactured materials or on the long term strength and performance of sands used as structural fill.  **ASPHALT AGGREGATE**  **SOURCE MATERIALS**  Granite and Gneiss Source Materials  These rock types can be defined as follows [10]:   * Granite – ‘A plutonic rock in which quartz makes up 10 to 50 percent of the felsic components and the alkali feldspar / total feldspar ratio is 65 to 90 percent.’ * Gneiss – ‘A foliated rock formed by regional metamorphism, in which bands or lenticles of granular minerals alternate with bands or lenticles of minerals with flaky or elongate prismatic habit.’   Mica has the potential to exfoliate when heated in a hot-mix plant (coarse feldspars can potentially also disintegrate) which can weaken the aggregate but can also generate micaceous fines. Micaceous fines can have a relatively high surface area to mass ratio due to their platy mineral structure, and this can influence the coating capacity of the bitumen. A small percentage increase in fines content gives a disproportionate increase in surface area ratio.  Blending of Asphalt Aggregate  Refer to “Blending of Sealing Aggregates”, above.  In addition to the blending principles for sealing aggregates, the following also applies:   1. **Inert materials**. The source materials must be inert at all stages. Particular attention should be given to asphalt aggregates in the production process.   Tolerances are derived from the Fuller and Thompson grading curve (see Reference [4]), with a variance in the exponent.  **PRODUCT QUALITY CONTROL**  ‘Accurate and consistent sizing is essential to allow for control of the AC mix design.’ [1]  Tolerances are used to control the target gradings for approved design asphalt mixes. AS 2758.5 Table 1 also specifies tolerances, although these are different to the DPTI requirements, specifically for the allowable tolerance for 1.18 mm sieve size. AS2758.5 allows ± 6% tolerance on the 1.18mm sieve whereas Part R15 indicates ±1% tolerance. Tolerances have been specified in consultation with industry to determine targets that are considered measurable and achievable. (See file knet #4256867 – DPTI internal document).  Particle Shape (Flakiness, Elongation)  Limits are placed on the proportion of flaky or elongated particles as these particles are less able to form a tightly packed aggregate skeleton within an asphalt mix. Flakey and elongated particles reduce the workability of the asphalt and are vulnerable to fracture during compaction. The specified values have been in place for many years and provide acceptable performance for normal duty asphalt mixes. For very heavy traffic applications, consideration should be given to reducing the specification limit for Flakiness to 25. (Refer AGPT04B-07 Table B11 [Reference 12]).  Los Angeles Value  Aggregates for asphalt manufacture must be durable for the life of the asphalt and able to withstand abrasion and crushing during manufacture. This requires a relatively hard aggregate but the support provided to coarse aggregate within the asphalt matrix by the bituminous mastic means that a higher Los Angeles value can be used for asphalt aggregates compared to sealing aggregates. The specified values of 30% to 35% have proven suitable over many years of experience and are consistent with values recommended by Austroads. For very heavy traffic applications, consideration should be given to reducing the specification limit for Los Angeles Value to 25% (Ref AGPT04B-08 Table B9 [Reference 12]).  PAFV  Micro texture is a measure of the surface roughness of an aggregate particle and is significant in determining the frictional characteristics of an asphalt wearing course in which the aggregate particles lie flat to the surface. As a result, aggregates with a higher PAFV than for spray sealing are required for asphalt. Asphalts also tend to be used in urban or rural areas where traffic loadings are high and so are subject to the polishing action of traffic during their service life. While dense graded asphalts also have a mastic of sand and bitumen that contributes to surface microtexture, open graded and stone mastic asphalts are more heavily reliant on the microtexture of the coarse aggregate for surface friction and so a higher PAFV is specified. Sites requiring a higher level of skid resistance, such as heavily trafficked sharp curves, or high stress braking areas may also warrant a higher level of polishing resistance.  The specified values for PAFV for asphalt aggregates are intended to reflect the diversity of road geometry, traffic loading, asphalt mix types and performance, and available aggregate sources to ensure that aggregates selected for specific sites are fit for their intended purpose.  Water Absorption and Density  Good quality aggregates should be dense and of low porosity. A porous aggregate will absorb more binder and tend to produce an asphalt mix that is dry or less cohesive. As a result, additional binder is required to compensate for the binder absorbed by the aggregate. Reporting this information allows the mix designer to better determine the optimum binder content.  **MINERAL FILLER FOR ASPHALT, OTHER THAN HYDRATED LIME**  Gradings  This information is required for mix design purposes.  Voids in Compacted Dry Filler  This information is required for mix design purposes.  Moisture Content  Fillers are usually handled as dry powders through pneumatic materials handling systems. Moisture will cause blockages to occur.  Specific Surface  This is a measure of particle shape as characterised by surface area to volume ratio. This influences binder film thickness and binder viscosity and is required for mix design purposes (AGPT04B-07 Cl A7.2 [12]).  Loss on Ignition  The origin of the limit of 4% is from AS 3582.1 for Fly Ash.  Water Soluble Fraction  The origin of the limit of 20% is from typical specifications for Cement Works Flue Dust (RMS 3211 [18]).  **ADDITIONAL REQUIREMENTS FOR BASIC IGNEOUS SOURCE ROCK**  Basalts are available in the South East region of South Australia and have a similar geological history to those found in Victoria. The performance of these basalts as pavement materials or aggregates can vary from suitable to unsuitable depending on the proportion of secondary minerals found in the source rock. These specification requirements have been adapted from research works undertaken in Victoria and implemented by Vicroads in their specifications.  [See also: Part R15 Commentary Clause 2 under “Quality Plan, Procedures and Documentation”; Clause 4 under “Secondary Mineralisation”; Clause 5 under “Testing”]  Secondary Mineral Content (AS 1141.26)  In this test, the proportion of secondary minerals is estimated from thin rock sections using a petrological microscope fitted with a point counting device. This provides a measure of mineralogical composition and does not involve any failure mechanism. The test limits were developed through empirical correlations with the performance of Melbourne basalts and subsequently with other basalt in Victoria, where secondary minerals are largely smectite clays. A high secondary mineral content in basaltic rocks correlates with poor durability in service. (Ref AGPT04J-08)  Accelerated Soundness Index (AS 1141.29)  This test is applied to basaltic sources and involves the measurement of the proportion of fines produced after a number of cycles of immersion of an aggregate in boiling ethylene glycol. Distress is by fracturing due to stresses induced by enhanced swelling/contraction of expansive clay minerals and to thermal stresses. The test is primarily sensitive to the presence of smectite clays. Low values correlate to poor durability. (Ref AGPT04J-08)  Unsound Stone Content  This is not strictly a “test” but rather a procedure which classifies aggregate particles by visual comparison with reference specimens that have been classified as “Sound”, “Marginal” or “Unsound” in accordance with the Secondary Mineral Content and Accelerated Soundness Index tests described above. High proportions of unsound stone are correlated with poor durability in service. (Ref AGPT04J-08).  **ARRESTOR BED MATERIAL**  **SOURCE MATERIALS**  Requirements for source material and product quality control tests are based on the Austroads Guide to Road Design (2010), Part 6, “Roadside Design, Safety and Barriers”, Chapter 7 “Design for Steep Downgrades”, including Table 7.6 “Arrestor bed material specification”.  Product quality control tests are also taken from the suggested specifications from Cocks et al (1982) [3].  The aim of arrestor bed material testing is to select a stone that results in a suitable deceleration of vehicles entering the arrestor bed. ‘The effectiveness of arrestor beds in stopping runaway vehicles results from the interaction between vehicle motion and gravel movements. The forces acting on the vehicles can be divided into several components; air force, drag force, and drag force between gravels and the vehicle. Drag force is generated through two mechanisms: 1) momentum that is imparted from the truck to the gravels and 2) the shear energy generated when the gravels are moved.’ [8]  Arrestor bed material may be used either as a ‘top up’, for full replacement or for a new arrestor bed.  The material can be purchased directly from a quarry or from a landscape supplier.  Key principles that apply to the specification of Arrestor Bed Material are:   * Smooth rounded single sized particles will have low levels of shear resistance to wheel loads and provide little support to the load. * Minimising the proportion of fine aggregates and dust (< 9.5mm) reduces the potential for coarser aggregates to lock together through mechanical interlock or by cohesion. * Smooth rounded particles will have a greater tendency to slide against each other than angular particles under the application of a wheel load. Limiting the proportion of fractured faces and mis-shapen particles reduces the degree of mechanical interlock that can develop. * Crush resistant particles will retain their desirable performance properties in service for an extended time. * The movement of heavy particles will dissipate a greater amount of energy than light particles   In conjunction with purchase of material for “top up” purposes, periodic rescreening of arrestor bed material may be required to remove a build-up of fines that can accumulate over time, e.g. wind-blown dust, erosion sediments or vehicle induced contamination.  \_\_\_\_\_\_\_\_\_\_\_\_ |

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1. From Harvey (2014), broadly speaking, ‘the area of aperture of a square sieve is twice the area of the next smaller sieve in the series, e.g. for two adjacent sieves in the series, a 13.2 mm aperture is twice the area of a 9.5 mm aperture.’ [↑](#footnote-ref-1)