

Code of Practice

Source Rock Investigations

RC 500.00

1. Scope

This Code of Practice details the process for source rock investigations, subsequent inspections and accreditation of materials supply for use in VicRoads works.

Source rock investigations are an integral part of VicRoads accreditation process and the assessment of the quality of crushed rock and aggregate products.

The purpose of the investigations is to facilitate the sampling and testing of source rock and to provide suitable reference specimens for use in Test Methods:

- RC 372.01 - *Coarse Aggregate Quality by Visual Assessment*,
- AS 1141.30.1 - *Methods for sampling and testing aggregates – Coarse aggregate quality by visual comparison, and*
- AS 1141.30.2 - *Methods for sampling and testing aggregates – Preparation of aggregate reference specimens for visual comparison.*

2. Definitions

Rock Type

Rock is classified as igneous, metamorphic or sedimentary as described below. The general classification scheme adopted and typical rock nomenclatures are shown in AS 1726, Tables A6(a) and A6 (b).

Igneous Rock

Rock formed by solidification from a molten or partially molten state.

Sedimentary Rock

Rock formed by the lithification or consolidation of mineral grains or rock fragments, or the product of chemical action.

Metamorphic Rock

Rock derived from pre-existing rock by mineralogical, textural, chemical and structural alteration due to changes in pressure, temperature or the chemical environment, or any combination of these three processes.

Source Rock

The rock mass which is proposed to be used in the production of crushed rock or aggregate. The source rock can be quarry rock or non quarry rock.

Quarry Rock

An in situ rock mass located in an operating quarry or a part of a quarry.

Shot Rock

Rock loosened in bulk from the rock mass.

Non Quarry Rock

Material obtained from an excavation site other than an operating quarry e.g. construction or demolition site, which is usually processed by an on-site portable crushing plant but may be taken to a nearby site for processing.

Material Type

Rock obtained from within a site, which is distinguishable on the basis of colour, texture, hardness, the degree of weathering and test properties. There are two types:

- Major Type - A material type which represents 10% or more of the crushed product.
- Minor Type - A material type which represents less than 10% of the crushed product.

Rock Durability Classification

The classification of a material type in accordance with the durability requirements of VicRoads Standard Specification Section 801-*Source Rock for the Production of Crushed Rock and Aggregates*. Material types are classified as sound, marginal or unsound.

Reference Specimen

A small representative quantity of crushed particles, usually of 10mm nominal size, prepared from a material type which is subsequently used in the assessment of the quality of coarse aggregates in accordance with Test Method RC 372.01.

Source Rock Investigation/Inspection

An examination of a site which can include an assessment of the areas of extraction, and sampling of source rock to enable classification of material types and production of Reference Specimens. It can also include the sampling of crushed products,

to allow VicRoads accreditation of the site and the assignment of Los Angeles Value and Polished Stone Value where applicable.

3. Classification of Rock

Identification of Metamorphic Rock Sources

VicRoads Standard Specification Section 801 specifies source rock test limits for igneous, metamorphic and sedimentary rock types. Section 801 relies on the distinct separation of rock types for the application of the appropriate tests and test limits. As the boundary between sedimentary and metamorphic rocks is often poorly defined, further guidance is required to identify metamorphic rocks.

For the purpose of this code, source rock is classified as metamorphic if it contains rock in which the relevant degree of re-crystallisation as shown in Table 1 (refer Appendix B) has been reached.

A source will be classified as metamorphic if more than 60 per cent of the rock can be classified as metamorphic, as defined above, or can be identified as having attained that grade in the case of rock which is now weathered. Source rock tests appropriate to metamorphic rock types shall be applied to all material sampled from that source.

Non Quarry Rock

Source rock obtained from an excavation site other than an operating quarry will be regarded as "non quarry rock" and may be accredited for use in the manufacture of products as defined in Table 801.033 of VicRoads Standard Specification Section 801.

Where non quarry source rock is accredited for use by VicRoads, the Supplier will receive a formal communication of any conditions or additional requirements pertaining to the supply and the assignment of Los Angeles Value based on VicRoads testing of the crushed product.

Note : The Guide Notes accompanying VicRoads Standard Specification Section 801 provide further information in regard to the use of non quarry rock.

Newer Basalt Surface Rock

Basalt plains to the west of Melbourne are characterised by the presence of basalt 'floaters' or surface rock. This rock has been found to be consistently hard and durable. This rock excavated during construction works may be a suitable source for crushed rock and aggregate production. Processing of the rock may take place on site or at a nearby quarry. After inspection, VicRoads may classify such sites as an accredited source of 'Newer Basalt Surface Rock'. VicRoads maintains a generic set of reference specimens titled 'Newer Basalt Surface Spalls'. This reference specimen set can be made available to suppliers to facilitate the determination of unsound rock content in crushed rock and aggregate products.

Other Sources of Non Quarry Rock

Periodically, suitable source rock for the production of crushed rock and aggregate products may be encountered in rock cuttings and adjacent to road reserves. The use of these sources will require the approval of VicRoads based on a full source rock investigation and the preparation of a dedicated set of reference specimens. VicRoads may require additional durability and production tests to be carried out prior to accreditation of the source rock.

4. Frequency of Investigation

The frequency of investigation of a particular source is governed by the rate of production for VicRoads works, the complexity of the source rock and the potential for poor quality materials to be encountered. VicRoads will determine the category for individual sites and the frequency of investigation/inspection will be as shown in Table 2.

Table 2. Frequency of Investigation

| Category of Quarry | Investigations or Inspections per year (minimum) |
|---|--|
| Major supplier (> 600k tonnes per annum) | 3 |
| Intermediate supplier (200-600k tonnes per annum) | 2 |
| Minor supplier (< 200k tonnes per annum) | 1 (or on request) |

The specified frequency does not preclude additional investigations being carried out as a result of:

- a temporary high rate of production for VicRoads works, i.e. major freeway/highway pavement works,
- a request by the quarry operator or VicRoads,
- an apparent change in the quality of the operating face,
- an apparent change in the quality of the supplied products, or
- inadequacy of the reference specimens for visual assessment of the products.

The frequency of investigation appropriate for each site and the proposed program of investigations are formulated on an annual basis.

Non Quarry rock sources will be investigated initially, and re-assessed whenever any new material is added to unprocessed rock stockpiles. The maximum size of stockpile to be assessed shall not exceed 35,000 tonnes.

5. Sampling and Testing of Source Rock and/or Products

The source rock investigations are carried out by a suitably qualified and experienced person.

Method of Sampling

The methods of sampling shall be in accordance with AS 1141.3.1 and AS 1141.3.2 with the following exceptions:

- Sampling will be of material types present within a rock face rather than a rock face itself;
- Samples will be normally taken from shot rock rather than rock face due to Occupational Health & Safety requirements.

Specified Tests

The applicable test methods are listed in Appendix A. The specified tests on source rock and crushed products are shown in Table 3 (Refer Appendix B).

The assigned Los Angeles Value is based on test results for samples from current production. Bulk samples obtained for testing shall represent the typical product available at the site with regard to stone quality. The preferred gradings for use in the Los Angeles Value test are J or K, as detailed in AS 1141.23, which correspond to the common sizes of aggregate for pavement surfacing.

Polished Stone Values are specified for Class A sealing aggregate and wearing course asphalt aggregates. Testing is undertaken on the crushed products of sources which are capable of supplying such materials. Assessment is based on source rock quality, proven and potential reserves, source location and the assigned Los Angeles Value. Samples obtained for Polished Stone Value testing shall be 10 mm nominal size aggregates and must conform to all relevant product hardness and quality requirements of VicRoads Standard Specifications.

6. Frequency of Sampling and Testing

Source Rock

Each major and minor material type is sampled from the rock faces or shot rock at the initial investigation. When a new material type is identified in the source, the Supplier shall notify VicRoads Technical Consulting, who shall arrange for the sampling and classification of this material type. Appropriate tests as detailed in Table 3 (refer Appendix B) will be performed on these samples.

At subsequent investigations, a material type is generally re-sampled and tested as follows:

- (a) when there is an apparent change in the quality of the material type in the source,

- (b) when the reference specimen has discoloured, and

- (c) when there has been degradation of the reference specimen through handling.

Product

The frequency of sampling and testing of the product is shown in Table 4 (refer Appendix B).

7. Assessment of Test Results

Durability

For the purposes of classification of a material type, the results obtained from the Degradation Factor-Source Rock test shall be rounded to the nearest 5.

Where the test results obtained for a material type indicate a durability classification different from the current classification, one additional sample shall be obtained and tested before a decision regarding reclassification of the material type is made.

In instances where visually similar samples have different durability classifications, the sample which has the lowest classification shall be issued as a reference specimen.

For basic igneous rocks (e.g. basalts) where the Secondary Mineral Content and the Accelerated Soundness Index are both specified for the assessment of durability, the rock shall be classified on the basis of the lower rock quality classification derived from the two tests.

Hardness

The Los Angeles Value for a source is assigned by VicRoads on the basis of test values obtained from product samples. The assigned Los Angeles Value is reviewed annually or as necessary on the basis of additional test data.

Resistance to Polishing

The Polished Stone Value for a source is assigned by VicRoads on the basis of test values obtained from product samples. The assigned Polished Stone Value is reviewed annually or as necessary on the basis of additional test data.

Selective Quarrying

It is acknowledged that some quarries, by selective quarrying, may be able to produce limited quantities of material of higher quality than that indicated by the assigned Los Angeles Value and/or assigned Polished Stone Value. Written approval from VicRoads Technical Consulting is required to supply crushed products on this basis.

8. Accreditation

Upon the completion of satisfactory initial source rock testing, a source will be accredited by VicRoads and assigned values formally issued to the Supplier, for Los Angeles Value and Polished Stone Value, as appropriate.

9. Reference Specimens

It is essential that all particles in a reference specimen are visually similar. The VicRoads officer responsible for sampling must check for and discard any foreign particles. If contamination is excessive, the reference specimen and the test results should be discarded and another sample should be obtained and tested.

The VicRoads officer responsible for the sampling will determine which reference specimens are to be prepared for issue.

The reference specimens will be placed in containers which are labeled with the appropriate details shown in Table 5.

Issue of Reference Specimens

One set of reference specimens will be made available to the appropriate Supplier or his agent. A second set will be made available, on request, for use at another location.

The set of reference specimens is reassessed after each source rock investigation. A list of reference specimens currently applicable to the source is prepared and is forwarded to the Supplier along with the newly issued reference specimens. An up to date set of reference specimens is maintained in the VicRoads laboratory.

The reference specimens and the identifying list in the Supplier's laboratory remain the property of VicRoads, however the Supplier management is responsible for their secure storage, maintenance and good order.

Bodies external to VicRoads will not be given access to any sets of reference specimens, any quarry information e.g. assigned values etc. or quarry investigation reports held within VicRoads unless prior permission is obtained from both the Supplier and from VicRoads –Technical Services. A record of supplier permission must be maintained of any such access permitted.

If the reference specimen set appears to be inadequate to perform product control for a source, VicRoads Technical Services should be notified so that a further investigation of the source rock can be undertaken. If sampling and testing of the material are found to be necessary, the classification and reference specimens will be made available within 21 working days of receipt of the written notification.

Table 5. Reference Specimen Labels

| | |
|---|---------|
|  | |
| TEST METHOD RC 372.01 Reference Specimen | |
| ROCK SOURCE: | |
| ROCK TYPE: | |
| BENCH: | FACE: |
| LOCATION: | |
| DATE SAMPLED: | |
| REPORT No: | Lab No: |
| SOUND | |

| | |
|---|---------|
|  | |
| TEST METHOD RC 372.01 Reference Specimen | |
| ROCK SOURCE: | |
| ROCK TYPE: | |
| BENCH: | FACE: |
| LOCATION: | |
| DATE SAMPLED: | |
| REPORT No: | Lab No: |
| MARGINAL | |

| | |
|---|---------|
|  | |
| TEST METHOD RC 372.01 Reference Specimen | |
| ROCK SOURCE: | |
| ROCK TYPE: | |
| BENCH: | FACE: |
| LOCATION: | |
| DATE SAMPLED: | |
| REPORT No: | Lab No: |
| UN SOUND | |

10. Reporting

A record of the investigation, including samples obtained and test results, shall be forwarded to the Supplier or nominated representative.

A report on each investigation is also made available to VicRoads staff in the Materials Surveillance Database.

The reports (or contents of) must not be issued to external bodies or third parties without written permission of the Supplier.

Reports shall include the following:

- (a) Identification and location of the site using Melway or VicRoads Directory map and grid system,
- (b) List of current reference specimens,
- (c) Copy of test results,
- (d) Comment, if required, on the test results obtained,
- (e) Where appropriate, a photograph(s) or sketch of the sample locations in the quarry faces.
- (f) The current assigned Los Angeles Value,
- (g) The current assigned Polished Stone Value (where applicable), and
- (h) The presence (or otherwise) of sulphide mineralisation in the source rock.

Appendix A

List of Test Methods Used

| | |
|---------------|--|
| AS 1141.3.1 | Methods for sampling and testing aggregates – Sampling – Aggregates |
| AS 1141.3.2 | Methods for sampling and testing aggregates – Sampling – Rock spalls, boulders and drill core |
| AS 1141.23 | Methods for sampling and testing aggregates – Los Angeles Value |
| AS 1141.25.1 | Methods for sampling and testing aggregates – Degradation factor – Source rock |
| AS 1141.26 | Methods for sampling and testing aggregates – Secondary minerals content in igneous rocks |
| AS 1141.29 | Methods for sampling and testing aggregates – Accelerated soundness index by reflux |
| AS 1141.30.1 | Methods for sampling and testing aggregates – Coarse aggregate quality by visual comparison |
| AS 1141.30.2 | Methods for sampling and testing aggregates – Preparation of aggregate reference specimens for visual comparison |
| AS 1289.4.3.1 | Determination of pH value of a soil (Electrometric Method) |
| AS 1726 | Geotechnical site investigations |
| RC 353.09 | Soluble salts in soil |
| RC 370.03 | Texas Ball Mill Value |
| RC 372.01 | Coarse Aggregate Quality by Visual Assessment |
| RC 374.01 | Polished Stone Value |

Code of Practice - Revision Summary

RC 500.00 Source Rock Investigations

| Date | Clause Number | Description of Revision | Authorised by |
|---------------|---------------|--|---|
| December 2012 | Full document | Re-styled with minor amendments & corrections made | Principal Advisor – Pavements & Materials |
| Dec 2012 | Table 2 | Minimum number of investigations or inspections per year on Major Suppliers reduced to 3 | Principal Advisor – Pavements & Materials |
| | | | |

Appendix B

Table 1. Identification of Low Grade Metamorphic Rocks

| Original Sediment | Contact Metamorphism | | Regional Metamorphism | |
|---|---|--|--|-----------------------|
| | Degree of Recrystallisation | Typical Rock Types | Degree of Recrystallisation | Typical Rock Types |
| 1. Argillaceous e.g. mudstone, siltstone, claystone. | biotite and/or cordierite present | quartz/biotite hornfels, cordierite hornfels | biotite present | phyllite, schist |
| 2. Arenaceous (a) pure e.g. sandstone | quartz grain boundaries show interlocking mosaic | quartzite | quartz grain boundaries show interlocking mosaic | quartzite |
| (b) impure e.g. greywacke | biotite present | quartz/biotite hornfels | biotite present | quartz/mica schist |

Other types of metamorphic rock are not described as they rarely occur in Victoria or they are rarely used by VicRoads as a source of aggregate.

Table 3. Tests on Source Rocks and Products

| Tests on | Material Property | Rock Type | Specified Tests |
|------------------|--|------------------------------------|--|
| Source rock only | Durability | Igneous (other than basic igneous) | Degradation Factor-Source Rock |
| | | Basic Igneous | Secondary Mineral Content Accelerated Soundness Index |
| | | Metamorphic | Degradation Factor-Source Rock |
| | | Sedimentary | Texas Ball Mill Value |
| Product | Sulphide Mineralisation Hardness Resistance to Polishing | All All All | pH and Conductivity Los Angeles Value Polished Stone Value |

Table 4. Minimum Frequency for Los Angeles Value and Polished Stone Value

| Material Property | Test | Assigned Values for the Source | Major Supplier | Intermediate Supplier | Minor Supplier |
|-------------------------|----------------------------|--------------------------------|----------------|-----------------------|---|
| Hardness | Los Angeles Value (LA V) | LAV ≤ 15 * | 1 per year | Every 2 years | Initial test and then as required by VicRoads |
| | | LAV > 15 | 2 per year | 1 per year | Every 2 years |
| Resistance to Polishing | Polished Stone Value (PSV) | PSV < 54 LAV < 26 | Every 2 years | Every 3 years | Every 4 years |
| | | PSV ≥ 54 LAV < 26 | Every 2 years | Every 3 years | Initial test and then as required by VicRoads |

All testing shall be undertaken on crushed product sampled by VicRoads.

* Small variations in test values for sources with an assigned Los Angeles Value of 15 or less are not critical with regard to requirements of VicRoads Standard Specifications