

TRANSPORT FOR NSW (TfNSW)

QA SPECIFICATION 3152

AGGREGATES FOR ASPHALT

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REVISION REGISTER

| Ed/Rev Number | Clause Number | Description of Revision | Authorised By | Date |
|---------------|---------------|---|------------------------|----------|
| Ed 1/Rev 0 | | First issued. | GM, IC | 29.07.09 |
| Ed 2/Rev 0 | | New edition. | GM, IC | 23.05.11 |
| Ed 2/Rev 1 | Global | Minor editing to improve clarity. | GM, CPS Peter Letts | 23.01.14 |
| | 3 | Added abbreviation for “BOS”. | | |
| | 5.1 | Term “metallurgical slag” changed to “BOS steel furnace slag”. | | |
| | 5.2 | BOS steel furnace slag added to list of permitted fine aggregate. | | |
| | 5.3 | Tables 1 and 2: free lime content limits of BOS steel furnace slag and associated test method, and corresponding footnote added to Table. | | |
| | Annex L1 & L2 | Minimum Frequency of Testing: free lime content and corresponding footnote added to Table. | | |
| | Annex M | Added AS 1141.3.1 and ASTM C114-10. | | |
| Ed 2/Rev 2 | Global | Minor editing and rewording to improve clarity. | GM, CPS | 02.03.15 |
| | Guide Notes | Guide Notes on use of coarse EAF steel furnace slag aggregates for asphalt, including testing, added. | | |
| | 3 | Abbreviation for “EAF” added. | | |
| | 5.1 | Heading added to form new clause 5.1. Subsequent clauses renumbered. | | |
| | 5.2 | Option for use of EAF steel furnace slag as coarse aggregates added. Requirements for steel furnace slag to be processed to remove metallic coarse particles and to be weathered for 28 days added. | | |

| Ed/Rev Number | Clause Number | Description of Revision | Authorised By | Date |
|------------------------|---------------------------------|--|----------------------|-------------|
| Ed 2/Rev 2 (cont'd) | 5.3 8.3.1 Annex L | Table 1: Acceptance criteria for water absorption and free lime content of coarse EAF steel furnace slag aggregates added. Table 2: Acceptance criterion for water absorption of fine BOS steel furnace slag aggregates revised. Reduction in frequency of testing for steel furnace slag aggregates prohibited. Requirement for testing of steel furnace slag aggregate over and above the minimum frequency of testing added. Note (4) – sampling requirements for BOS steel furnace slag aggregates also applicable to EAF steel furnace slag aggregates. | | |
| Ed 2/Rev 3 | 5.2 (i) | Statement on processing of slag aggregates reworded to clarify requirement. | MCQ | 15.07.15 |
| Ed 2/Rev 4 | Global | References to “Roads and Maritime Services” or “RMS” changed to “Transport for NSW” or “TfNSW” respectively. | DCS | 22.06.20 |

GUIDE NOTES

(Not Part of Contract Document)

Using Specification 3152

Refer to Technical Direction 2006/06 concerning the requirements of PAFV for various aggregates.

Edition 2 Revision 1

Edition 2 Revision 1, introduced requirements which aims to minimise the potential for expansion of steel furnace slag aggregates used in asphalt intermediate layers and wearing courses.

This includes mandating that all steel furnace slag aggregates from suppliers must be from certified stockpiles, and be fully weathered before being transported to the asphalt plant.

Edition 2 Revision 2

Edition 2 Revision 2 introduced the option for use of coarse EAF steel furnace slag aggregates for asphalt, and requires the Supplier to maintain auditable records of the weathering process and stockpile management as part of its Quality Management System for steel furnace slag aggregates.

It also prohibits any reduction to the minimum frequency of testing set out in Annexure 3152/L for steel furnace slag aggregates, and requires the Supplier to carry out additional testing to ensure that uniform aggregates are delivered to the asphalt producer.

Edition 2 Revision 3

Amended Clause 5.2 to clarify that discrete metallic coarse steel furnace slag aggregates must be removed during processing of the coarse aggregates.



AGGREGATES FOR ASPHALT

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| VERSION FOR: DATE: |
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FOREWORD

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REVISIONS TO PREVIOUS VERSION

This document has been revised from Specification TfNSW 3152 Edition 2 Revision 3.

All revisions to the previous version (other than minor editorial and project specific changes) are indicated by a vertical line in the margin as shown here, except when it is a new edition and the text has been extensively rewritten.

PROJECT SPECIFIC CHANGES

Any project specific changes are indicated in the following manner:

- (a) Text which is additional to the base document and which is included in the Specification is shown in bold italics e.g. *Additional Text*.
- (b) Text which has been deleted from the base document and which is not included in the Specification is shown struck out e.g. ~~Deleted Text~~.

TfNSW QA SPECIFICATION 3152

AGGREGATES FOR ASPHALT

1 SCOPE

This Specification sets out the requirements for the supply and delivery of coarse and fine aggregates for use in asphalt.

2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

2.1 PROJECT SPECIFIC REQUIREMENTS

Project specific requirements are shown in Annexure 3152/A.

2.2 SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

The schedules in Annexure 3152/C list the **HOLD POINTS** that must be observed. Refer to Specification TfNSW Q for the definition of **HOLD POINTS**.

The records listed in Annexure 3152/C are **Identified Records** for the purposes of TfNSW Q Annexure Q/E.

2.3 FREQUENCY OF TESTING

The minimum frequency of testing is shown in Annexure 3152/L.

You may propose to the Principal that a reduced minimum frequency of testing be accepted in accordance with TfNSW Q. Support your proposal by a statistical analysis verifying consistent process capability and product characteristics.

In the event of a nonconformity, a reduced frequency of testing must revert immediately to the specified minimum frequency of testing.

2.4 REFERENCED DOCUMENTS

Unless specified otherwise, the applicable issue of a referenced document, except for TfNSW specifications, must be the issue current at the date one week before the closing date for tenders.

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure 3152/M.

3 DEFINITIONS AND ABBREVIATIONS

The term “the Supplier” means the supplier of the product covered by the scope of this Specification.

A Lot is a stockpile or multiple stockpiles with the same source properties and the same production parameters.

The following abbreviations apply to this Specification:

| | |
|-------------|---|
| BOS | Basic Oxygen Steelmaking |
| EAF | Electric Arc Furnace |
| NATA | National Association of Testing Authorities |
| PAFV | Polished Aggregate Friction Value |
| SMA | Stone mastic asphalt |

4 SUPPLIER’S QUALITY MANAGEMENT SYSTEM

The Supplier must establish and maintain a Quality Management System complying with AS/NZS ISO 9001 as a means of ensuring that the product conforms to this Specification. Provide evidence verifying compliance with this Clause.

Maintain records of the weathering process (refer Clause 5.2) and stockpile management of steel furnace slag aggregates as part of the Quality Management System. The Principal may audit the records for compliance.

5 MATERIALS

5.1 GENERAL

Test each type and source of aggregates separately.

All aggregate materials must be conforming, and have a uniform appearance for the duration of the work.

Take measures to ensure that materials supplied to the work do not exhibit any expansive reactions resulting from the presence of free Calcium Oxide, Magnesium Oxide or other expansive materials.

5.2 COARSE AGGREGATE

Coarse aggregates must consist of either crushed rock, gravel, or BOS or EAF steel furnace slag, that is clean, dry, hard, tough, sound and free from dust, clay, dirt or other deleterious matter.

Steel furnace slag must be:

- (i) processed to be free from discrete metallic coarse particles;
- (ii) weathered for a minimum of 28 days from the time of stockpiling.

Coarse aggregates must not deteriorate rapidly at the quarry face or when placed in stockpiles, and must not fracture during compaction.

Coarse aggregates must conform to the requirements of Table 3152.1.

5.3 FINE AGGREGATE

Fine aggregates are materials having nominal size of 5 mm or less and must consist of one or a combination of the following:

- (a) (i) (fine) aggregate, and/or
- (ii) secondary and/or tertiary crusher dusts (such crusher dusts may be washed and/or classified prior to use),

resulting from the manufacture of the coarse aggregate.

Where the source rock is different from that used to produce the coarse aggregate, the source rock must also meet the strength and durability requirements specified in Table 3152.1. A Hold Point applies prior to the first use of this fine aggregate.

HOLD POINT

| | |
|------------------------|--|
| Process Held: | First use of a fine aggregate produced from a different source rock to that used to produce the coarse aggregate. |
| Submission Details: | Documents as detailed in Clause 5.3, and in particular item (a)(ii), including source, at least 7 working days before the nominated aggregate is proposed to be delivered. |
| Release of Hold Point: | The Principal will consider the submitted documents prior to authorising the release of the Hold Point. |

- (b) clean natural quartz sands.
- (c) clean quartz sand derived from processing sandstone provided that, when determined by point count, the proportion of bonded quartz grains must not exceed 2.5%.
- (d) BOS steel furnace slag.

Fine aggregates must also conform to the requirements shown in Table 3152.2.

Table 3152.1 – Coarse Aggregate Requirements

| Coarse Aggregate Requirements | Acceptance Criteria | Test Method |
|---|--|------------------------------|
| Particle size distribution | Asphalt manufacturer's nominated grading envelope | AS 1141.11 |
| Material finer than 75 µm | Report | AS 1141.12 |
| Particle shape (for fraction retained on 9.5 mm AS sieve for each constituent aggregate nominal size): | | |
| (i) using 2:1 calliper ratio | ≤ 25% | AS 1141.14 |
| (ii) using 3:1 calliper ratio | ≤ 10% | AS 1141.14 |
| Ratio of greatest to least dimension of aggregate fractions < 10 mm nominal size for aggregates used in SMA | ≤ 2.1 | TfNSW T278 |
| Fractured face(s) for aggregates derived from gravels and meta-sediments: | | TfNSW T239 |
| (i) at least two fractured faces | ≥ 85% | |
| (ii) at least one fractured face | ≥ 100% | |
| Strength and durability: | | |
| (i) Wet strength | ≥ 150 kN | TfNSW T215 |
| (ii) Wet/dry strength variation | ≤ 35% | TfNSW T215 |
| Frictional characteristic - Polished Aggregate Friction Value (PAFV) | Wearing course ≥ 48 ⁽¹⁾ All other courses ≥ 44 | AS 1141.41 and AS 1141.42 |
| Water absorption: | | AS 1141.6.1 |
| (i) BOS and EAF steel furnace slag aggregate | ≤ 2.5% | |
| (ii) Rhyolite aggregate | Report | |
| (iii) All other aggregate types | ≤ 2.5% | |
| Apparent density: | | |
| Dry density | Report all | AS 1141.6.1 |
| SSD density | Report all | AS 1141.6.1 |
| Free lime content: | | ASTM C114-10 ⁽²⁾ |
| (i) BOS steel furnace slag aggregates | ≤ 6% | |
| (ii) EAF steel furnace slag aggregates | ≤ 3% | |

Notes:

⁽¹⁾ Unless specified otherwise in Annexure 3152/A.

⁽²⁾ Use Test Method B as detailed in Section 29 of ASTM C114-10. The testing must be carried out at the steel furnace slag aggregates supplier's premises before transport to the asphalt plant.

Table 3152.2 – Fine Aggregate Requirements

| Fine Aggregate Requirements | Acceptance Criteria | Test Method |
|---------------------------------------|---|-----------------------------|
| Particle size distribution | Asphalt manufacturer's nominated grading envelope | AS 1141.11 |
| Material finer than 75 µm | Report | AS 1141.12 |
| Angularity for aggregates used in SMA | ≥ 43% | AASHTO T304-96 Method A |
| Water absorption: | | AS 1141.5 |
| (i) BOS steel furnace slag aggregates | ≤ 4.0% | |
| (ii) Quartz sands | ≤ 1.5% | |
| (iii) All other types of aggregates | ≤ 3.0% | |
| Soundness | ≤ 12% weighted loss | AS 1141.24 |
| Apparent density: | | |
| Dry density | Report all | AS 1141.5 |
| SSD density | Report all | AS 1141.5 |
| Free lime content: | | |
| BOS steel furnace slag aggregates | ≤ 6% | ASTM C114-10 ⁽¹⁾ |

Notes:

⁽¹⁾ Use Test Method B as detailed in Section 29 of ASTM C114-10. The testing must be carried out at the steel furnace slag aggregates supplier's premises before transport to the asphalt plant.

5.4 PARTICLE SIZE DISTRIBUTION

The actual coarse and fine aggregates particle size distribution may vary from the nominated value within the tolerances shown in Table 3152.3.

The nominated particle size distribution and associated nominated grading envelope must form part of the PROJECT QUALITY PLAN.

Table 3152.3 – Permissible Variation to Nominated Particle Size Distribution of Coarse or Fine Aggregate (% by mass of aggregate)

| Description | Tolerance |
|-------------------------------------|------------------|
| Passing 26.5 mm AS sieve and larger | ± 10 |
| Passing 4.75 mm to 19.0 mm AS sieve | ± 8 |
| Passing 1.18 mm and 2.36 mm | ± 6 |
| Passing 0.300 mm and 0.600 mm | ± 5 |
| Passing 0.150 mm | ± 3 |
| Passing 0.075 mm | ± 2 |

6 NOMINATED AGGREGATE

The nominated aggregate submission is your statement of the quality of your aggregate that will:

- (a) satisfy the requirements of this Specification; and
- (b) be targeted during production and supply.

6.1 SUBMISSION OF NOMINATED AGGREGATE

Submit to the Principal the following details:

(a) Aggregate Characteristics:

- (i) Source and geological type.
- (ii) Production plant and methods of winning materials.
- (iii) Evidence that the source and methods proposed are adequate for the required quantity and quality of aggregate.
- (iv) Nominated target values for each characteristic specified in Tables 3152.1 and 3152.2.

Note: Aggregate of different type or quality from the same face or quarry will be regarded as a different source.

(b) Production Trial:

- (i) Test results of a trial production from the plant which will supply the aggregates. Submit such test results for each aggregate requirement in Clause 5.
- (ii) All tests for each nominated aggregate must be from the same trial production.

(c) Signed Statement:

Provide a signed statement certifying that each nominated aggregate meets the requirements of Clause 5. The statement must include NATA endorsed test results for all specified tests. Attach a copy of your completed verification checklist.

All tests relating to the submission must be carried out within the following periods prior to the date of submission to the Principal:

- (i) three months for properties related to the manufacturing process, and
- (ii) six months for source properties

except for PAFV where the results must not be older than 12 months.

All phases of any particular test must be performed at the same laboratory.

6.2 PROPRIETARY INFORMATION

This Specification sets minimum technical standards and requires details of aggregates, plant and quality verification to be provided.

Clearly identify in the submission any details that are not provided because they are considered to be proprietary information, together with a proposal outlining each point of such details and an alternative method of risk management on behalf of the Principal.

6.3 SUPPLY OF NOMINATED AGGREGATE

HOLD POINT

Process Held: Supply of nominated aggregate.

Submission Details: At least 7 days prior to the proposed date of delivery of the nominated aggregate, submit the documents detailed in Clause 6.

Release of Hold Point: The Principal will consider the submitted documents prior to authorising the release of the Hold Point.

7 (NOT USED)

8 CONFORMITY

Verify conformity with the Specification by sampling and testing, and providing records of process control.

8.1 HOMOGENEITY

Divide aggregate of segregated appearance into sub-Lots such that each sub-Lot contains only that quantity of aggregate which is visually homogeneous. Each sub-Lot must separately comply with the requirements of this Specification.

8.2 SAMPLING

Nominate all sampling locations, frequencies and methods in your PROJECT QUALITY PLAN. Samples must be representative of materials used in asphalt production.

In addition to the requirements of Annexure Q/L of TfNSW Q, and unless specified or agreed otherwise with the Principal, define boundaries of sub-Lots represented by a single tested sample are deemed to be the midpoints in production between the sample points.

When the Principal requests samples, riffle and/or quarter the samples taken for testing, and deliver the samples in sealed and labelled containers.

8.3 TESTING

8.3.1 Additional Frequency of Testing Requirements

For steel furnace slag aggregates, the minimum frequency of testing specified in Annexure 3152/L must not be reduced.

If necessary, the Supplier must carry out further testing over and above the minimum frequency of testing, to verify the uniformity of aggregates. The costs of the further testing will be borne by the Supplier.

8.3.2 Maximum Lot Size

The maximum Lot size must be in accordance with TfNSW Q and, notwithstanding TfNSW Q, must not exceed 4,000 tonnes.

8.4 NONCONFORMITIES

If a Lot fails to conform to this Specification, such failure will constitute a nonconformity under the Contract.

Where the Principal considers that a nonconformity in the aggregate supply will adversely affect asphalt performance, do not use the aggregate in asphalt production.

Remove any nonconforming aggregate that has been delivered to the Principal's premises.

The cost of rectification or replacement, including any restoration to the work and to the Principal's premises or property that becomes necessary as a result of such rectification or replacement, will be borne by you.

Rectified and replacement aggregates must conform to this Specification.

ANNEXURE 3152/A – PROJECT SPECIFIC REQUIREMENTS

The requirements below apply to the Contract:

NOTES TO TENDER DOCUMENTER: (Delete this boxed text after customising Annexure 3152/A)

Where “Yes / No” options are shown below, delete whichever option that is not applicable.

Use multiple copies to cater for different pavement designs under the same Contract.

| Clause | Project Specific Requirement: | Requirement |
|---------------|--|--------------------|
| 5 | Minimum Polished Aggregate Friction Value (PAFV) (aggregates for use in wearing course) | |
| 5 | Aggregates for use in stone mastic asphalt (SMA) | Yes / No |

ANNEXURE 3152/B – (NOT USED)

ANNEXURE 3152/C – SCHEDULES OF HOLD POINTS AND IDENTIFIED RECORDS

Refer to Clause 2.2.

C1 SCHEDULE OF HOLD POINTS

| Clause | Description |
|--------|--|
| 5.3 | Where fine aggregate is produced from a different source rock to that used to produce coarse aggregate, verification that source rock conforms to specified strength and durability requirements for coarse aggregate. |
| 6.3 | Submission of nominated aggregate details. |

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW Q Annexure Q/E.

| Clause | Description of Identified Record |
|----------|--|
| 5.2, 5.3 | Nominated coarse and fine aggregate grading envelope |
| 6.1 | Nominated aggregate submission |
| 6.2 | Proprietary information not submitted, and alternative method of risk management |
| 8.3.1 | Test reports of all specified properties and characteristics |

ANNEXURES 3152/D TO 3152/K – (NOT USED)

ANNEXURE 3152/L – MINIMUM FREQUENCY OF TESTING

Refer to Clause 2.3.

L1 COARSE AGGREGATES

| Total Mass of Material Represented (tonnes) | | 1 - 500 | 501 - 1000 | 1001 - 2000 | 2001 - 4000 |
|--|---|--|------------|-------------|-------------|
| Test Method | Characteristic Analysed | Minimum Frequency of Testing | | | |
| AS 1141.11 | Particle size distribution | 1 | 1 | 2 | 3 |
| AS 1141.12 | Material finer than 75 µm by washing | 1 | 1 | 2 | 3 |
| AS 1141.14 | Particle Shape ⁽¹⁾ | 1 | 1 | 2 | 3 |
| TfNSW T278 | Ratio of greatest to least dimension ⁽²⁾ | | | | |
| TfNSW T239 | Fractured Faces | 1 | 2 | 3 | 4 |
| TfNSW T215 | Wet Strength ⁽³⁾ | 1 | 1 | 2 | 3 |
| TfNSW T215 | Wet/Dry Strength Variation ⁽³⁾ | 1 | 1 | 2 | 3 |
| AS 1141.41, AS 1141.42 | PAFV | 1 per 12 months and at change in quarry face | | | |
| AS 1141.6.1 | Water Absorption | 1 per 6 months and at change in quarry face | | | |
| AS 1141.6.1 | Density | 1 per 6 months and at change in quarry face | | | |
| ASTM C114-10 | Free lime content ⁽⁴⁾ | 2 | 3 | 4 | 5 |

Notes:

- ⁽¹⁾ Any change in production parameters must initiate the commencement of a new Lot.
- ⁽²⁾ Only for aggregates to be used in SMA (refer Specification TfNSW R121).
- ⁽³⁾ Refer Clause 8.3.1. Provided that for the six previous Lots actually tested, all tests have met specification requirements for both Wet Strength and Wet/Dry Strength Variation, then the following reduced frequencies apply:

| Wet/Dry Strength Variation | Frequency of Testing |
|----------------------------|----------------------|
| < 25% | 1 per 10,000 tonnes |
| < 30% | 1 per 4,000 tonnes |
| < 35% | 1 per 2,000 tonnes |

- ⁽⁴⁾ BOS and EAF steel furnace slag aggregates must be tested from certified stockpile Lots at the supplier's premises. Sampling must be carried out using a sampling tube as described in AS 1141.3.1 with all samples taken from at least 300 mm away from the face of the stockpile. Use the sampling technique detailed in Annexure A5 in AS 1141.3.1. Alternative sampling may be carried out using AS 1141.3.1 Section 9.3 "Backblading method" but the samples must not be mixed to form an average from the Lot.

L2 FINE AGGREGATES

| Total Mass of Material Represented (tonnes) | | 1 - 500 | 501 - 1000 | 1001 - 2000 | 2001 - 4000 |
|--|--------------------------------------|---|------------|-------------|-------------|
| Test Method | Characteristic Analysed | Minimum Frequency of Testing | | | |
| AS 1141.11 | Particle size distribution | 1 | 1 | 2 | 3 |
| AS 1141.12 | Material finer than 75 µm by washing | 1 | 1 | 2 | 3 |
| AASHTO T304-96 Method A | Angularity ⁽¹⁾ | 1 | 1 | 2 | 3 |
| AS 1141.5 | Water Absorption | 1 per 6 months and at change in quarry face | | | |
| AS 1141.24 | Soundness | 1 per 6 months and at change in quarry face | | | |
| AS 1141.5 | Density | 1 per 6 months and at change in quarry face | | | |
| ASTM C114-10 | Free lime content ⁽²⁾ | 2 | 3 | 4 | 5 |

Notes:

- ⁽¹⁾ Any change in production parameters must initiate the commencement of a new Lot.
- ⁽²⁾ Only for aggregates to be used in SMA (refer Specification TfNSW R121).
- ⁽³⁾ BOS steel furnace slag aggregates must be tested from certified stockpile Lot at the Supplier's premises. Sampling must be carried out using a sampling tube as described in AS 1141.3.1 with all samples taken from at least 300 mm away from the face of the stockpile. Use the sampling technique detailed in Annexure A5 in AS 1141.3.1. Alternative sampling may be carried out using AS 1141.3.1 Section 9.3 "Backblading method" but the samples must not be mixed to form an average from the Lot.

ANNEXURE 3152/M – REFERENCED DOCUMENTS

Refer to Clause 2.4.

TfNSW Specifications

| | |
|------------|---------------------------|
| TfNSW Q | Quality Management System |
| TfNSW R121 | Stone Mastic Asphalt |

TfNSW Test Methods

| | |
|------------|---|
| TfNSW T215 | Wet/Dry Strength Variation |
| TfNSW T239 | Fractured Faces of Coarse Aggregate |
| TfNSW T278 | Aggregate Shape by the Ratio of Greatest to Least Dimension |

Australian Standards

| | |
|-----------------|---|
| AS/NZS ISO 9001 | Quality management systems – Requirements |
|-----------------|---|

Australian Standard Test methods

| | |
|-------------|--|
| AS 1141 | Methods for sampling and testing aggregates |
| AS 1141.3.1 | Sampling – Aggregates |
| AS 1141.5 | Particle density and water absorption of fine aggregate |
| AS 1141.6.1 | Particle density and water absorption of coarse aggregate – Weighing-in-water method |
| AS 1141.11 | Particle size distribution – Sieving method |
| AS 1141.12 | Materials finer than 75 micrometre in aggregates (by washing) |
| AS 1141.14 | Particle shape, by proportional caliper |
| AS 1141.24 | Aggregate soundness – Evaluation by exposure to sodium sulphate solution |
| AS 1141.41 | Polished aggregate friction value – Horizontal bed machine |
| AS 1141.42 | Pendulum friction test |

AASHTO Test Methods

| | |
|---------|------------|
| T304-96 | Angularity |
|---------|------------|

ASTM Test Methods

| | |
|---------|---|
| C114-10 | Standard Test Methods for Chemical Analysis of Hydraulic Cement |
|---------|---|