# Sand Seal Quality Assurance (QA) Guide

## *Description: Sand Seal*

A sand seal is the application of emulsified asphalt following immediately by an application of a single layer of fine graded cover aggregate. The sand seal may be applied in multiple lifts depending on traffic demands and existing road surface conditions. Emulsified asphalt binders shall meet the requirements of rapid-setting, medium-setting, or cationic slow-setting type emulsified asphalt in M 140 or M 208. The emulsified asphalt residue hardness classification is determined by the Owner Agency utilizing regional climatic and traffic conditions. Aggregate must be durable consisting of crushed stone, gravels, or manufactured aggregates varying in size from 3/8 in (9.5 mm) to a minimum of No. 8 sieve size (2.38 mm).

## *Quality Assurance (QA)*

AASHTO R 10 provides standard definitions for terms used in quality assurance procedures. They include:

- QA is defined as all those planned and systematic actions taken by the Agency and Contractor to provide the necessary confidence that the procured material and workmanship will satisfy the quality requirements of the contract.

- QA includes Quality Control (QC), Acceptance and Independent Assurance (IA).

- QC is the system used by the Contractor to monitor, assess, and adjust production and placement processes to ensure that the material and workmanship will meet the specified quality. QC is the responsibility of the Contractor.

- Acceptance is the system used by the Agency/Engineer to measure the degree of compliance of the quality of the materials and workmanship with the Contract requirements for payment. Acceptance is the responsibility of the Agency/Engineer and will be conducted in accordance with these Specifications.

- IA is an unbiased and independent system used to assess all sampling, testing and inspection procedures used for QA. IA is the responsibility of the Agency/Engineer and is conducted in accordance with these Specifications.

## *I. Quality Control (QC)*

### 1. General

The sand seal contractor (the Contractor) shall establish, implement and maintain a QC program to control all equipment, materials, workmanship and processes during sand seal construction. The Contractor's QC program shall include preconstruction activities

including sand seal design, site preparation, material handling and transportation, and stockpiling. The program shall include procedures required for sampling, testing, inspection, monitoring, documentation, and corrective action procedures during transport, stockpiling, placement and finishing operations.

A written Quality Control Plan shall be developed which details the Contractor's QC program that meets the requirements of these specifications. The QC Plan shall be contract specific and signed by the Contractor's representative. Sand seal construction shall not proceed without Agency acceptance of the QC Plan and QC personnel present on the job. Failure to comply with the provisions of this provision will result in shutdown of the operation until such time as the Contractor's operation is complying.

**2. Reference Documents**

a. AASHTO M 140 Standard Specification for Emulsified Asphalt
b. AASHTO M 208 Standard Specification for Cationic Emulsified Asphalt
c. AASHTO M 316 Standard Specification for Polymer-Modified Emulsified Asphalt
d. AASHTO M 344 Materials for Sand Seals
e. AASHTO R 10 Standard Practice for Definition of Terms Related to Quality and Statistics as Used in Highway Construction
f. AASHTO R 18 Standard Recommended Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
g. AASHTO R 38 Standard Practice for Quality Assurance of Standard Manufactured Materials
h. AASHTO R 66 Standard Practice for Sampling Asphalt Materials
i. AASHTO R 77 Standard Practice for Certifying Suppliers of Emulsified Asphalt
j. AASHTO R 78 Standard Practice for Recovering Residue from Emulsified Asphalt Using Low-Temperature Evaporative Techniques
k. AASHTO R 90 Standard Practice for Sampling Aggregate Products
l. AASHTO R 106 Standard Practice for Sand Seal Design
m. AASTHO T 11 Standard Method of Test for Materials Finer Than 75-micro m (No. 200) Sieve in Mineral Aggregates by Washing
n. AASHTO T 19 Standard Method of Test for Bulk Density ("Unit Weight") and Voids in Aggregate
o. AASHTO T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregate
p. AASHTO T 44 Standard Method of Test for Solubility of Bituminous Materials
q. AASHTO T 49 Standard Method of Test for Penetration of Asphalt Materials
r. AASHTO T 51 Standard Method of Test for Ductility of Asphalt Materials
s. AASHTO T 59 Standard Method of Test for Emulsified Asphalts
t. AASHTO T 85 Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
u. AASHTO T 96 Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine (ASTM C 131-01)

v. AASHTO T 104 Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
w. AASHTO T 111 Standard Method of Test for Mineral Matter or Ash in Asphalt Materials
x. AASHTO T 301 Standard Method of Test for Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
y. AASHTO T 335 Standard Method of Test for Determining Percentage Fracture of Coarse Aggregate
z. Federal Lands Highway (FLH) T 508 Flakiness Index Value
aa. 23 CFR 637 Construction Inspection and Approval
bb. AASHTO Guide Specification for Highway Construction, 2020, 10th edition

**3. Definitions**

a. Agency – a state highway agency, other agency or owner responsible for the final acceptance of the project.
b. Calibration – any calibration, standardization, check or verification as required by the test method or standard.
c. Contractor – the prime contractor who has ultimate control of the project.
d. Supplier – one who produces the final product materials (i.e. aggregates and asphalt emulsion) used on the project.
e. Standard – any standard, specification, test method, practice, etc. utilized to achieve compliance with the contract.
f. Testing Lab – the laboratory conducting quality control tests (contractor or supplier) and acceptance tests (agency).

**4. Personnel**

a. Responsibilities and Requirement of QC Staff - at a minimum, provide the name of the person responsible for each position listed below, including their telephone number, email, and their qualifications/certifications.
    i. QC Plan Manager. The person responsible for the execution of the QC Plan and liaison with the Agency. This person shall be on the job and have the authority to stop or suspend construction operations.
    ii. QC Technicians. The person(s) responsible for conducting QC tests and inspection to implement the QC Plan. QC Technicians shall have Level 2 Aggregate Testing certification from the American Concrete Institute (ACI), or other certification program approved by the agency
b. Certified Contractor Staff - at a minimum, one crew member (job foreman, supervisor, or other with decision making authority) has the experience of successfully constructing sand seals.

**5. QC Testing Laboratories and Equipment**

a. The laboratory that performs the QC for production can be either qualified or agency approved. The Contractor shall provide the name of the agency approved lab for all tests within the relevant scope of testing.
b. Testing and sampling equipment and measuring devices shall meet the

requirements of the specified standards and test methods. The lab shall maintain records of the calibration and maintenance of all sampling, testing, and measuring equipment, and all documents required by the agency.

c. Placement Equipment Calibration – prior to the commencement of work, the asphalt emulsion distributor and aggregate spreader shall be calibrated in the presence of the Agency representative utilizing the materials to be used on the project.

6. **QC Activities.** QC activities shall include monitoring, inspection, sampling, and testing. The Contractor's QC activities shall cover all aspects that affect the quality of the materials and workmanship of the sand seal. If there is no agency specific requirement, the minimum QC activities and frequencies required are listed as follows:
    a. Component materials
    b. Transportation material handling
    c. Application rates by a qualified lab
    d. Test strip construction and assessment
    e. Placement and finishing product
    f. Performance (i.e. no bleeding nor raveling issues)
    g. Review of material certifications supplied by vendors and suppliers

| MINIMUM AGGREGATE QC REQUIREMENTS | | |
|---|---|---|
| **Process Control Test** | **Test Method** | **Minimum Frequency** |
| Gradation* | AASHTO T 27<br>AASHTO T 11 | Prior to construction for design, then once per day of placement and every change of source. |
| Unit Weight | AASHTO T 19 | Prior to construction for design, then every change of source. |
| Bulk Specific Gravity | AASHTO T 85 | Once, prior to construction for design, then every change of source. |
| Aggregate Absorption | AASHTO T 85 | Once, prior to construction for design, then every change of source. |
| L.A. Abrasion | AASHTO T 96 | Once, prior to construction for design, then every change of source. |
| Soundness | AASHTO T 104 | Once, prior to construction for design, then every change of source. |
| Deleterious Material | AASHTO T 112 | Once, prior to construction, then every change of source. |
| Fractured Faces | AASHTO T335 | Once, prior to construction, then every change of source. |
| Flakiness Index | FLH T 508 | Prior to construction for design, then every other day of placement or change of source. |
| Application Rate | Truckload Yield Check, Tarp on Roadway | Once at startup each production day. |

* Aggregate samples will be taken at the project stockpile site using AASHTO R 90 Method B. Gradation test results should be provided within 24 hours.

| MINIMUM ASPHALT EMULSION QC REQUIREMENTS* | | |
|---|---|---|
| **Tests on Emulsion**** | | |
| Process Control Test | Test Method | Minimum Frequency |
| Viscosity | AASHTO T 59 or T 382 | Once per 200 tons (180 Mg) of material placed. |
| Temperature | N/A | Once per delivery tanker. |
| Particle Charge | AASHTO T 59 | Prior to loading emulsion distributor |
| Demulsibility | AASHTO T 59 | Once per 200 tons (180 Mg) of material placed. |
| Sieve | AASHTO T 59 | Once per 200 tons (180 Mg) of material placed. |
| Storage Stability | AASHTO T 59 | Once per 200 tons (180 Mg) of material placed. |
| Residue*** | AASHTO R 78-16 | Once per 200 tons (180 Mg) of material placed. |
| Application Rate | Computer Printout, Volumetric Measurement, Plate on Roadway | Once at startup each production day, then each 500 tons of aggregate placed. |
| **Tests on Residue** | | |
| Process Control Test | Test Method | Minimum Frequency |
| Solubility | AASHTO T 44 | Once per 200 tons (180 Mg) of material placed. |
| Penetration | AASHTO T 49 | Once per 200 tons (180 Mg) of material placed. |
| Ductility | AASHTO T 51 | Once per 500 (450 Mg) tons of material placed. |
| Ash Content | AASHTO T 111 | Once per 200 (180 Mg) tons of material placed. |
| Elastic Recovery | AASHTO T 301 | Once per 500 tons (450 Mg) of material placed. |

*Emulsified asphalt stored over a previous winter shall not be used.

** A material certification from the supplier shall be provided with each delivery tanker. Asphalt emulsionsamples will be taken at the point of delivery from the delivery tanker using AASHTO R 66.

*** Determined by either AASHTO T 59 or agency approved method.

7. **Contractor's Quality Control Plan.** The Contractor shall submit a written project specific, signed QC Plan to the Agency for acceptance at least 15 days prior to placement. The QC Plan shall detail the Contractor's plans, policies, procedures, and organization deemed necessary to measure and control materials, equipment, and the sand seal placement process.

   The QC Plan shall be maintained to reflect the status of the operations. Changes must be approved by the Agency prior to implementation.

   At a minimum, the QC Plan shall detail the following:

   a. **Scope of the QC Plan.** Reference all applicable specifications.
   b. **Definitions.** Terms used in the QC Plan shall be clear and distinct.
   c. **QC Organization.** Include a QC organizational chart identifying all personnel responsible for implementing the QC Plan and how they integrate and

communicate within the Contractor's management structure and the Agency. Include a list of QC personnel with their names, qualifications, responsibilities, certifications, telephone number and e-mail address.

**d. QC Testing Facilities and Equipment.** Include the location and qualifications of QC testing facilities, and a listing of all QC testing equipment with the frequency of calibration and verification.

**e. Materials Control.** Include the sources of all materials used in construction of the sand seal. Describe stockpile management practices, including segregation mitigation, loading, and transport procedures.

**f. QC Activities.** Describe QC activities deemed necessary to control all aspects of sand seal construction. Include the locations, surface preparation, construction methods, frequency and personnel responsible for conducting QC sampling, testing, and inspection. Identify lot/sublot sizes, sample identification system and sampling storage/retention procedures.

**g. Surface Preparation.** Describe the methods, equipment and materials needed to prepare the existing surface for a sand seal. All cracks greater than 0.5 in width should be filled. Allow crack sealant material to cure for a minimum of 30 days on pavement surfaces that have been crack sealed before application of the sand seal. In addition, ensure that all patches are flush with clean edges and the entire pavement section is structurally sound and no patch is less than 30 days old.

**h. Sand Seal Placement and Workmanship.** Describe methods, equipment and materials for construction of the sand seal. Identify methods to ensure proper workmanship:

i. Equipment calibration for distributor and aggregate spreader
ii. Monitoring application rates
iii. Ensure proper spread patterns
    a) Proper application rates without excessive or inadequate aggregate
    b) Emulsion drilling or flushing
    c) Longitudinal joint overlap
    d) Transverse joints
iv. Rolling operations, proper number of passes and coverage
v. Sweeping operations and schedule
vi. Method to control traffic

**i. Documentation.** Describe testing procedures and determine when corrective action is required. The contractor will provide examples of reporting forms, production QC test results, daily production records, non-conformance reports, and document retention details.

**j. Non-Conformance and Corrective Action.** Establish and maintain an effective and positive system for controlling non-conforming materials as indicated by inspection and test results. Investigate the cause of any non-conformance to prevent recurrence and take prompt corrective action to correct conditions that have resulted, or could result, in the incorporation of non-conforming materials into the work. All non-conforming materials shall be positively identified to prevent use and intermingling with conforming materials. Include procedures

and personnel responsible for directing corrective action including suspension of work and disposal or reworking of non-conforming materials. Detail how the results of QC inspections and tests will be used to determine corrective actions, define rules to gauge when a process is out of control and associated corrective action to be taken. At minimum, establish corrective action procedures for each control requirement listed above.

8. **Records and Documentation.** The Contractor shall maintain complete records of all QC tests and inspections.

   All QC test results shall be submitted to the Agency within 24 hours or upon request. A material certification shall be submitted from each supplier for each batch of material delivered to the jobsite, including test results.

   The QC records shall contain all test and inspection reports, forms and checklists, equipment calibrations, supplier material certificates, and non-conformance and corrective action reports. The QC records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities conforming and non-conforming, and the nature of corrective action taken as appropriate for materials as well as workmanship. The QC records shall always be available to the Agency and shall be retained for the life of the contract. The Contractor's documentation procedures will be subject to approval by the Agency prior to the start of work, and to compliance checks by the Agency during the progress of the work.

9. **Compliance with Specifications.** At the conclusion of the project, the Contractor shall attest in writing to the Agency that the sand seal has been constructed in accordance with and meets the requirements of the specifications.

## *II. Agency Acceptance*

1. **General**
   As the owner of the final sand seal, the Agency must ensure the contractor has constructed the project in accordance with the specifications. The Agency will conduct acceptance sampling, testing, and inspections consistent with AASHTO R 10. The agency may conduct verification testing if QC results are used for Acceptance.

2. **Acceptance Activities**
   a. Assure the Contractor has followed the approved QC Plan.
   b. Materials – monitor all contractor QC testing.
   c. Agency to sample and test:
      i. Aggregate – Gradation, moisture content, and deleterious materials, once per day or at the discretion of the Agency.
      ii. Asphalt Emulsion – Once per project or at the discretion of the Agency.

Note: Actual frequency and lot size will be per each Agency's Frequency Guide Schedules for Verification, Sampling and Testing.

d. Traffic control conforms to plans and specifications and complies with the Manual on Uniform Traffic Control Devices.
e. Surface Preparation – Monitor and approve sweeping methods, verify surface is clean and dry, inlets and manhole covers are protected.
f. Calibration – Witness the calibration of the asphalt emulsion distributor and aggregate spreader.
g. Asphalt Emulsion Distributor – Verify equipment has been calibrated and is in proper operating condition. Monitor for an even application of emulsified asphalt.
h. Aggregate Spreader – Verify equipment has been calibrated and is in proper operating condition. Monitor for an even application of material. Ensure spreader is proper distance from asphalt distributor.
i. Pneumatic Rollers – Verify equipment is in proper operation condition and rollers are positioned in echelon so the entire width of the pavement lane is covered. Roll three complete passes over the aggregate, with one pass defined as the roller moving over the sands in either direction.
j. Sweepers – Verify equipment is in proper operating condition. Ensure loose material is removed without damaging fresh sand seal.
k. Application Rates – Monitor and verify correct application rates of asphalt emulsion and cover aggregate.
l. Production Inspection – to be completed after final sweeping to check forunacceptable conditions, such as:
    i. Bleeding/flushing
    ii. Raveling/stone loss
    iii. Crushed/Broken Aggregate
    iv. Excessive longitudinal joint overlap
    v. Transverse joint overlap
m. Acceptance – to be completed after the production inspection.

## *III. Independent Assurance Program (IA)*

The IA program shall follow Tech Brief: Independent Assurance Programs, FHWA-HIF-12-001 2011 and shall be the responsibility of the Agency or Owner. The IA Program consists of activities that are unbiased and independent evaluations of all the observations, sampling and testing procedures and equipment used in the acceptance program. The IA Program is staffed by qualified agency personnel or an accredited laboratory not involved with acceptance testing. It ensures the sampling and testing is performed correctly, and the testing equipment used in the program is calibrated and operating correctly. IA involves a separate and distinct schedule of sampling, testing, and observation. Results of the IA testing shall not be used for material acceptance.