

UltraThin Bonded Wearing Course

Quality Assurance (QA) Guide

Description: UltraThin Bonded Wearing Course

An UltraThin Bonded Wearing Course (UTBWC) is a pavement preservation treatment used to extend the life of a structurally sound asphalt pavement (low to medium severity distresses such as rutting, bleeding, raveling, polished aggregates, friction loss) or Portland cement concrete pavement (spalling of longitudinal and transverse joints, corner breaks). The asphalt mixture portion of the UTBWC shall be a 1/2- to 1-in. (12.5- to 25.4-mm) thick, gap graded asphalt mixture. The asphalt binder for the asphalt mixture shall meet the requirements of M 320 or M 332. The aggregate should follow all requirements found in M 346 and it is recommended to follow the suggestions in the UTBWC construction guide. The polymer modified emulsified asphalt for UTBWC shall meet the requirements of **rapid-setting (RS-1P) or cationic rapid setting (CRS-1P)** type emulsified asphalt. Since UTBWC mixtures undergo more stress and than typical surface mixtures due to their thin-lift and rock-on-rock contact, the user should take caution to not use inferior materials or practices with this mixture.

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 UTBWC contractor (the Contractor) shall establish, implement and maintain a QC program to control all equipment, materials, workmanship and processes during UTBWC construction. The Contractor's QC program shall include preconstruction activities including UTBWC design, site preparation, material handling and transportation, and mobilization of materials. The program shall include procedures required for sampling, testing, inspection, monitoring, documentation, and corrective action procedures during transport, mobilization of materials, 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. UTBWC 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 R 10 Standard Practice for Definition of Terms Related to Quality and Statistics as Used in Highway Construction
- b. AASHTO R 18 Standard Recommended Practice for Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- c. AASHTO R 38 Standard Practice for Quality Assurance of Standard Manufactured Materials
- d. AASHTO R 66 Standard Practice for Sampling Asphalt Materials
- e. AASHTO R 77 Standard Practice for Certifying Suppliers of Emulsified Asphalt
- f. AASHTO R 78 Standard Practice for Recovering Residue from Emulsified Asphalt Using Low-Temperature Evaporative Techniques
- g. AASHTO R 108, Standard Practice for Ultrathin Bonded Wearing Course Design
- h. AASHTO M 316 Standard Specification for Polymer-Modified Emulsified Asphalt
- i. AASHTO M 320 Standard Specification for Performance-Graded Asphalt Binder
- j. AASHTO M 332 Standard Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test
- k. AASHTO T 11 Standard Method of Test for Materials Finer Than 75-micro m (No. 200) Sieve in Mineral Aggregates by Washing
- l. AASHTO T 19 Standard Method of Test for Bulk Density ("Unit Weight") and Voids in Aggregate
- m. AASHTO T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregate

- n. AASHTO T 44 Standard Method of Test for Solubility of Bituminous Materials
- o. AASHTO T 49 Standard Method of Test for Penetration of Asphalt Materials
- p. AASHTO T 51 Standard Method of Test for Ductility of Asphalt Materials
- q. AASHTO T 59 Standard Method of Test for Emulsified Asphalts
- r. AASHTO T 84 Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate
- s. AASHTO T 85 Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
- t. 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)
- u. AASHTO T 104 Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
- v. AASHTO T 111 Standard Method of Test for Mineral Matter or Ash in Asphalt Materials
- w. AASHTO T 112 Standard Method of Test for Clay Lumps and Friable Particles in Aggregate
- x. AASHTO T 176 Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- y. AASHTO T 210 Standard Method of Test for Aggregate Durability Index
- z. AASHTO T 301 Standard Method of Test for Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
- aa. AASHTO T 304 Standard Method of Test for Uncompacted Void Content of Fine Aggregate
- bb. AASHTO T 305 Standard Method of Test for Determination of Draindown Characteristics in Uncompacted Asphalt Mixtures
- cc. AASHTO T 327 Standard Method of Test for Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
- dd. AASHTO T 301 Standard Method of Test for Elastic Recovery Test of Asphalt Materials by Means of a Ductilometer
- ee. AASHTO T 335 Standard Method of Test for Determining Percentage Fracture of Coarse Aggregate
- ff. AASHTO T 382 Standard Method of Test for Determining the Viscosity of Emulsified Asphalt by a Rotational Paddle Viscometer
- gg. Tex-245-F Test Procedure for Cantabro Loss
- hh. 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, asphalt binder, asphalt mixture, 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 or other with decision making authority) has the experience of successfully constructing UTBWC.

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 spray paver 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 UTBWC. 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
- 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 AASHTO T 11	Prior to construction for design, then once per day of placement and every change of source.
Unit Weight	AASHTO T 19	Once, prior to construction, then every change of source.
Bulk Specific Gravity	AASHTO T 84 AASHTO T 85	Once, prior to construction, then every change of source.
Aggregate Absorption	AASHTO T 84 AASHTO T 85	Once, prior to construction, then every change of source.
L.A. Abrasion*	AASHTO T 96	Once, prior to construction, then every change of source.
Soundness	AASHTO T 104	Once, prior to construction, then every change of source.
Deleterious Material	AASHTO T 112	Once, prior to construction, then every change of source.
Sand Equivalent	AASHTO T 176	Once, prior to construction, then every change of source.
Durability	AASHTO T 210	Once, prior to construction, then every change of source.
Fine Aggregate Angularity	AASHTO T 304	Once, prior to construction, then every change of source.
Micro Deval	AASHTO T 327	Once, prior to construction, then every change of source.
Fractured Faces	AASHTO T 335	Once, prior to construction, then every change of source.

*Micro Deval (ASTM D6928) is an alternate tests that has been used in place of L.A. Abrasion.

MINIMUM ASPHALT BINDER FOR ASPHALT MIXTURE QC REQUIREMENTS		
Process Control Test	Test Method	Minimum Frequency
Polymer Modified Binder	AASHTO M 316	Once per every tank fill at the plant.
Performance Graded Binder	AASHTO M 320	Once per every tank fill at the plant.
Performance Graded Binder MSCR	AASHTO M 332	Once per every tank fill at the plant.
Elastic Recovery	AASHTO T 301	Once per every tank fill at the plant.

MINIMUM ASPHALT MIXTURE QC REQUIREMENTS		
Process Control Test	Test Method	Minimum Frequency
Draindown	AASHTO T 305	Once, prior to construction, then every change of source of aggregate or asphalt binder for asphalt mixture.
Cantabro Abrasion	Tex-245-F	Once, prior to construction, then every change of source of aggregate or asphalt binder for asphalt mixture.
Application Rate	Plant quantity verification	Once at startup each production day.

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	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.
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 emulsion samples 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 UTBWC 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 UTBWC. Describe mobilization of materials, material handling, loading, and transport procedures.
- f. **QC Activities.** Describe QC activities deemed necessary to control all aspects of UTBWC 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 UTBWC. 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 UTBWC. 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. **UTBWC Placement and Workmanship.** Describe methods, equipment and materials for construction of the UTBWC. Identify methods to ensure proper workmanship:
 - i. Equipment calibration for distributor and asphalt paver
 - ii. Monitoring application rates
 - iii. Ensure proper spread patterns
 - a) Proper application rates of asphalt mixture
 - b) Emulsion drilling or flushing
 - c) Longitudinal joint overlap
 - d) Transverse joints
 - iv. Rolling operations, proper number of passes and coverage
 - v. 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 UTBWC has been constructed in accordance with and meets the requirements of the specifications.

II. Agency Acceptance

1. General

As the owner of the final UTBWC, 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, deleterious materials, sand equivalent, durability, fine aggregate angularity, Micro Deval and fracture faces, once per day or at the discretion of the Agency.
 - ii. Asphalt binder for asphalt mixture – PG grade, MCSR, and elastic recovery, once per day or at the discretion of the Agency.
 - iii. Asphalt mixture – draindown and Cantabro abrasion, once per day or

at the discretion of the Agency.

- iv. 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 asphalt paver.
- g. Spray Paver – Verify equipment has been calibrated and is in proper operating condition. Monitor for an even application of emulsified asphalt and asphalt mixture.
- h. Steel Wheel 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 two complete passes over the UTBWC, with one pass defined as the roller moving over the UTBWC in either direction.
- i. Application Rates – Monitor and verify correct application rates of asphalt emulsion and asphalt mixture.
- j. Production Inspection - to be completed after final sweeping to check for unacceptable conditions, such as:
 - i. Bleeding/flushing
 - ii. Raveling/stone loss
 - iii. Crushed/Broken Aggregate
 - iv. Excessive longitudinal joint overlap
 - v. Transverse joint overlap
- k. 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.