
Standard Practice for Developing a Quality Assurance Plan for Hot Mix Asphalt (HMA)

AASHTO Designation: R 42-06 (2020)¹

**Tech Subcommittee: 5c, Quality Assurance
and Environmental**

Release: Group 1 (April)



**American Association of State Highway and Transportation Officials
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1. INTRODUCTION

- 1.1. This standard practice presents specific details necessary to effectively control the production and placement of hot mix asphalt (HMA).
- 1.2. *This standard practice may involve hazardous materials, operations, and equipment. This standard practice does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user of this standard practice to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. SCOPE

- 2.1. This standard practice provides the necessary quality assurance plan for control, verification, and acceptance of HMA pavement. It contains requirements for both quality control and acceptance.
- 2.1.1. This standard practice provides framework for a quality control plan that establishes minimum requirements and activities for a contractor's quality control (QC) system related to HMA production and placement. These requirements include a listing of the inspections and tests necessary to substantiate material and product conformance to the specifications. The primary method of field quality control employs the use of the Superpave gyratory compactor and evaluation of the volumetric properties of the mix.
- 2.1.2. This standard practice also provides framework for a plan that establishes acceptance requirements for an agency's assessment and acceptance of an HMA project.
- 2.2. The values stated in SI units are to be regarded as the standard.

3. REFERENCED DOCUMENTS

- 3.1. *AASHTO Standards:*
- [M 320](#), Performance-Graded Asphalt Binder
 - [M 323](#), Superpave Volumetric Mix Design
 - [M 332](#) Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test
 - [R 9](#), Acceptance Sampling Plans for Highway Construction

- [R 10](#), Definition of Terms Related to Quality and Statistics as Used in Highway Construction
- [R 18](#), Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- [R 26](#), Certifying Suppliers of Performance-Graded Asphalt Binders
- [R 30](#), Mixture Conditioning of Hot Mix Asphalt (HMA)
- [R 35](#), Superpave Volumetric Design for Asphalt Mixtures
- [R 46](#), Designing Stone Matrix Asphalt (SMA)
- [R 66](#), Sampling Asphalt Materials
- [R 76](#), Reducing Samples of Aggregate to Testing Size
- [R 90](#), Sampling Aggregate Products
- [R 97](#), Sampling Asphalt Mixtures
- [T 27](#), Sieve Analysis of Fine and Coarse Aggregates
- [T 30](#), Mechanical Analysis of Extracted Aggregate
- [T 164](#), Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA)
- [T 166](#), Bulk Specific Gravity (G_{mb}) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
- [T 176](#), Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test
- [T 209](#), Theoretical Maximum Specific Gravity (G_{mm}) and Density of Asphalt Mixtures
- [T 255](#), Total Evaporable Moisture Content of Aggregate by Drying
- [T 283](#), Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage
- [T 287](#), Asphalt Binder Content of Asphalt Mixtures by the Nuclear Method
- [T 304](#), Uncompacted Void Content of Fine Aggregate
- [T 308](#), Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method
- [T 312](#), Preparing and Determining the Density of Asphalt Mixtures Specimens by Means of the Superpave Gyratory Compactor
- [T 316](#), Viscosity Determination of Asphalt Binder Using Rotational Viscometer

3.2.

ASTM Standards:

- [C702/C702M](#), Standard Practice for Reducing Samples of Aggregate to Testing Size
- [D8](#), Standard Terminology Relating to Materials for Roads and Pavements
- [D2950/D2950M](#), Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods
- [D3665](#), Standard Practice for Random Sampling of Construction Materials
- [D3666](#), Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
- [D4791](#), Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate (withdrawn 2019)
- [D5361/D5361M](#), Standard Practice for Sampling Compacted Bituminous Mixtures for Laboratory Testing
- [D5821](#), Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
- [E29](#), Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- [E105](#), Standard Practice for Probability Sampling of Materials
- [E122](#), Standard Practice for Calculating Sample Size to Estimate, with Specified Precision, the Average for a Characteristic of a Lot or Process

- [E141](#), Standard Practice for Acceptance of Evidence Based on the Results of Probability Sampling

4. TERMINOLOGY

- 4.1. The terminology used in this standard is in accordance with [R 10](#) unless otherwise specified.
- 4.2. *hot mix asphalt (HMA)*—a mixture of aggregate and asphalt binder produced from an HMA plant.
- 4.3. *design mix formula (DMF)*—the single point target value for percent passing designated sieve sizes and volumetric properties developed in the laboratory before the start of production.
- 4.4. *job mix formula (JMF)*—the single point target value for percent passing designated sieve sizes and volumetric properties established after the initial production process to be used by the contractor for production quality control.
- 4.5. *performance-graded asphalt binder (PGAB)*—an asphalt-based cement that is produced from petroleum residue either with or without the addition of nonparticulate organic modifiers graded to temperature regimes and performance.
- 4.6. *quality assurance (QA)*—planned and systematic actions necessary to provide confidence that a product is in conformance with agency plans and specifications. It contains both QC and acceptance as two separate functions.
- 4.7. *quality control (QC)*—planned and systematic actions and considerations to control the level of quality being produced.
- 4.8. *QC plan*—project-specific plan that identifies methods of sampling, testing, calibration, QC monitoring, construction controls, paving plans, process balancing, and overall operations.
- 4.9. *acceptance*—sampling, testing, and assessment of test results to determine whether produced material and construction operation are in conformance with agency plans and specifications.
- 4.10. *independent assurance program (IAP)*—program developed by the agency to evaluate personnel and equipment used in the acceptance process on a project or system-wide basis.
- 4.11. *agency*—state highway agency or owner of the roadway.
- 4.12. Definitions of many common terms relating to HMA are contained in [ASTM D8](#).
- 4.13. Definitions of terms used in reference to other Standards are as defined therein.
- 4.14. Definitions of terms used in mathematical expressions are as generally used in standard practice. Unique terms are defined in the section containing the first presentation of such terms.

5. SUMMARY

- 5.1. This standard presents a procedure containing minimum requirements for QC and QA plans applicable to the production, placement, and acceptance of HMA. It incorporates the use of other available standards, which are appropriate to the accomplishment of this task. The requirements allow tailoring to accommodate the needs of an individual agency.

6. SIGNIFICANCE AND USE

- 6.1. Quality cannot be tested nor inspected into an HMA pavement. It must be built in through the implementation of properly designed QC and acceptance plans. The contractor should have a properly designed quality control plan and the agency should have a properly designed acceptance plan. The design and use of the plans is a critical step toward the successful manufacture, placement, and performance of HMA pavements.
- 6.2. This standard is used to aid in the completion of tasks noted in Sections 6.2.1 and 6.2.2.
 - 6.2.1. Implementation of a QC plan for a contractor(s).
 - 6.2.2. Implementation of an acceptance plan for an agency.
- 6.3. QC and acceptance plans conforming to this standard practice are applicable to HMA pavement construction projects. If an inconsistency exists between the contract documents and either plan, the contract documents should govern.

7. APPARATUS

- 7.1. *Laboratory Requirements:*
 - 7.1.1. Personal safety equipment required by the laboratory or OSHA for work in the HMA design and testing areas.
 - 7.1.2. Apparatus as required by referenced standards for this standard practice.
 - 7.1.3. All other laboratory apparatus needed to control the quality of HMA production and placement in accordance with project specifications.
- 7.2. *Field Requirements:*
 - 7.2.1. Personal safety equipment required by the field organization or OSHA.
 - 7.2.2. Field apparatus listed in standards referenced as requirements in this standard practice.
 - 7.2.3. All other field apparatus needed to control the quality of HMA production and placement in accordance with project specifications.
- 7.3. Apparatus required in Sections 7.1 and 7.2 should be furnished in the quantity necessary to assure that the materials and products used can be shown to conform to the HMA specification requirements without undue delay of the production and placement process.
- 7.4. Additional apparatus required for use by agency representatives for verification and acceptance activities should be provided by the agency unless otherwise specified.

8. STANDARDIZATION

- 8.1. Agency and contractor laboratories conducting work should satisfactorily participate in the AASHTO Materials Reference Laboratory (AMRL) proficiency sample program and should also be AMRL inspected. Alternately, a non-AASHTO laboratory qualification program that meets the same requirements could be used. Inspections or tests not covered by AMRL should comply with the applicable requirements of [R 18](#) and [ASTM D3666](#).

- 8.1.1. All apparatus should be calibrated, and the calibration verified at established intervals, relevant to AASHTO, ASTM, or agency standards.
- 8.2. Sampling and testing personnel should be qualified through procedures developed by the agency for obtaining samples, processing samples, inspection of work, operation of testing equipment, and test equipment validation.
- 8.3. Verify the calibration of the nuclear density gauge(s) using [ASTM D2950/D2950M](#) or another system approved by the agency.
- 8.4. Records demonstrating compliance with the equipment, personnel, and QC requirements should be available during construction for agency review.

9. FUNCTIONS AND RESPONSIBILITIES ON HMA PROJECTS

- 9.1. *Agency:*
 - 9.1.1. The agency should review and approve HMA volumetric mix designs proposed by the contractor and assess the adequacy of the contractor's QC plans. A reasonable time for review should be specified. The agency or a representative of the agency is responsible for all acceptance testing.
- 9.2. *Contractor:*
 - 9.2.1. The contractor should be responsible for the development and formulation of the DMF using [M 323](#), [R 35](#), and [T 312](#), which should be submitted to the agency for approval. The contractor should be responsible for the QC of all materials during the handling, blending, mixing, and placing operations. In addition, contractor tests may be used in the acceptance decision when a contractor acceptance program is developed by the agency in accordance with Section 14.5.

10. SAMPLING

- 10.1. *Initial Production Samples:*
 - 10.1.1. The contractor and the agency should obtain samples of HMA from plant-produced materials in accordance with [T 168](#) and the applicable procedures contained in Section 12.3 and Appendix X1. Samples should be reduced to testing size in accordance with [R 76](#) or [ASTM C702/C702M](#). Procedures for oven conditioning or reheating of samples should be established.
 - 10.1.2. The contractor and the agency should select sample locations on the control strip in accordance with Section 12.3 and Appendix X1. These locations are used for in-place density testing.
- 10.2. *Mix Production Samples:*
 - 10.2.1. The contractor should obtain samples for QC in accordance with [T 168](#), using a stratified random sampling plan in accordance with Section 13.3 for determining lot sizes and Appendix X1 or [ASTM D3665](#) for sample location. Samples should be reduced to testing size in accordance with [R 76](#) or [ASTM C702/C702M](#).
 - 10.2.2. The agency should obtain samples for acceptance in accordance with [T 168](#), using a stratified random sampling plan in accordance with Section 13.3 for determining lot sizes and Appendix X1 or [ASTM D3665](#) for sample location. Samples should be reduced to testing size in accordance with [R 76](#) or [ASTM C702/C702M](#).

- 10.3. *Sample Locations for In-Place Coring or Testing:*
- 10.3.1. The agency representative should select in-place sample locations in accordance with Section 13.3 for determining lot sizes, Appendix X1 for sample location, and when cores are required, [ASTM D5361/D5361M](#) for sampling.
- Note 1**—In addition to the random number tables in Appendix X1, [ASTM D3665](#) also contains a table of random numbers, including instructions for use. [R 9](#) and [ASTM E105](#), [E122](#), and [E141](#) contain additional information concerning sampling practices.

11. MATERIAL REQUIREMENTS

- 11.1. *Performance-Graded Asphalt Binder:*
- 11.1.1. PGAB should conform to the requirements of [M 320](#).
- 11.1.2. Quality control of PGAB from all suppliers should be in accordance with [R 26](#) or other programs approved by the agency.
- 11.2. *Aggregates:*
- 11.2.1. The agency should develop a testing program to ensure that aggregates meet specification requirements. The contractor's QC plan should include, as a minimum, discussion on the proposed processing, transportation, stockpiling, and plant charging operations.

12. FIELD ADJUSTMENT OF THE DMF

- 12.1. *Summary:*
- 12.1.1. During initial plant start-up, adjustments may be made during the initial lot production to assure the plant-produced HMA will meet the design requirements.
- 12.1.2. The contractor should be responsible for the operation of the HMA plant and the production of the HMA within the DMF limits in Table 1. The limits in Table 1 are also used to control the amount of deviation from the DMF that the contractor may use when declaring a JMF. The declared JMF should meet the requirements of [M 323](#).

Table 1—Allowable DMF Adjustments for Initial Production

HMA Composition Property	Adjustment Limit, %
Asphalt Binder Content (P_b)	±0.4
Gradation Passing 0.150-mm and Larger Sieves	±4.0
Gradation Passing 0.075-mm Sieve	±1.5
Voids in Mineral Aggregate (VMA)	±1.0
Voids Filled with Asphalt (VFA)	±5.0

- 12.2. *Initial Production Lot:*
- 12.2.1. At the beginning of production of each mixture required in the contract, an initial production lot should be used to evaluate the DMF. The initial production lot should be divided into four sublots as specified in Table 2 depending on the mixture type. The properties of the sublots will be measured and compared to the DMF. If the deviation in air voids in any sublot exceeds ±2.0 percent or in any two sublots exceeds ±1.5 percent, the production should cease and a new

DMF should be developed in accordance with Section 9.2. If the difference from the DMF for asphalt binder content in any subplot exceeds the limit shown in Table 1, the production should cease and a new DMF should be developed in accordance with Section 9.2. If the difference from the DMF for any property other than asphalt binder exceeds two times the limits shown in Table 1 or any two sublots exceed the limits shown in Table 1, the production should cease and a new DMF should be developed in accordance with Section 9.2.

Table 2—Initial Production Lots and Sublots

Nom Max Size, mm	Sublot (Mg or tons)	Lot (Mg or tons)
4.75	300	1200
9.5	400	1600
12.5	500	2000
19.0	500	2000
25.0	500	2000
37.5	500	2000

12.2.2. The last sample in the lot should be within the limits of Table 1. The initial production lot should be closed out and the contractor should declare a JMF. The lot should be accepted with a pay factor of 1.00. For material produced outside the tolerances of Section 12.2.1, the agency should determine if the material should be left in place. The agency should require that a JMF be declared after the initial production lot. Only one initial production lot should be allowed.

12.3. *Initial Production Lot Samples:*

12.3.1. The contractor should obtain, using the methods required by Section 10, a sample of plant-produced HMA from each subplot. Samples should be obtained from the mat behind the screed or from the haul trucks at the plant. Because the evaluation criteria are based on in-place measurements, it is recommended that QC testing be completed on road samples.

Note 2—If acceptance testing is performed on road samples, and the QC testing is based on truck samples taken at the HMA plant, the contractor should develop appropriate correlation factors.

12.3.1.1. Determine asphalt binder content and combined aggregate gradation of the HMA samples in accordance with [T 164](#) and [T 30](#), or [T 308](#), or [T 287](#) and [T 30](#) (on cold feed material).

12.3.1.2. Determine maximum theoretical specific gravity of the HMA samples in accordance with [T 209](#).

12.3.1.3. Compact samples of HMA according to [T 312](#).

12.3.1.3.1. Determine bulk specific gravity, G_{mb} , in accordance with [T 166](#), Method A.

12.3.1.3.2. Determine the air void content in accordance with [R 35](#) at N_{ini} and N_{des} gyrations.

12.3.1.4. Determine the VMA and the VFA in accordance with [R 35](#).

12.4. *Control Chart Initiation:*

12.4.1. A process control chart is needed to determine whether the manufacturing process is in control. Individual data points and moving averages are plotted. The individual data points indicate variability and the moving average indicates conformance to the target value. Control charts should comply with the requirements of Appendix X2.

- 12.4.2. When an HMA initial production lot has been produced, the contractor should establish initial control charts using single point target values from the JMF in accordance with the requirements of Appendix X3.
- 12.4.3. Control charts are used to graphically represent the continuous control process. They include the target value that is to be achieved for a certain material property and acceptable upper and lower limits. When a measured value is determined and plotted on the control chart, it should fall within the control limits. Mixture adjustment can be made in response to the values plotted on these control charts.
- 12.4.4. Control limits are established based on statistical concepts that assume the material parameter in question follows a normal distribution. Typically, the upper and lower control limits (UCL and LCL) are based on $\pm 2s$ (warning control limits) and $\pm 3s$ (action control limits), where s is the typical industry standard deviation listed in Table X3.1.
- 12.5. *HMA Control Strip:*
- 12.5.1. The contractor should place and compact the mixture produced during the initial production lot in order to establish that the equipment and the processes planned for placement and compaction are satisfactory.
- 12.5.2. The final compacted thickness of the HMA control strip should be the thickness required by the pavement cross-section.
- 12.5.3. The control strip should be a minimum of 150 m (500 ft) long.
- 12.5.4. After compaction is completed, ten cores should be taken at locations selected in accordance with Appendix X1. Density of the cores will be determined in accordance with [T 166](#).
- 12.5.5. The control strip will be considered acceptable when the average core density meets or exceeds contract specifications. The agency should specify limits for the number of control strips to be allowed.
- 12.5.6. The agency should determine a minimum density (e.g., 91.0 percent of [T 209](#)) above which the HMA in the control strip is allowed to remain in place and paid for with a pay factor of 1.00. For HMA with a density less than the minimum density, the agency should determine if the HMA should be left in place.

13. QUALITY CONTROL SYSTEM

- 13.1. *General Requirements:*
- 13.1.1. The contractor should provide and maintain a QC system that will provide reasonable assurance that all materials and products conform to the specification requirements whether manufactured or processed by the contractor or procured from suppliers or subcontractors. The contractor should perform or have performed the inspection and tests required to substantiate product conformance to the HMA design requirements, and should also perform or have performed all inspections and tests otherwise required by the project specifications. The contractor's QC procedures, inspections, and proposed testing should be documented in a written QC plan (see Appendix X3). The plan should be approved by the agency and be available for review through the life of the contract.
- 13.1.2. The contractor's QC plan should be based on tests performed to determine compliance of the HMA with the JMF. The tests should be performed on samples obtained using statistically sound, randomized sampling procedures in accordance with Section 10.

- 13.1.3. Typical QC HMA properties include asphalt binder content, maximum theoretical specific gravity, air voids, VMA, VFA, and percent passing key sieves in the combined gradation. Target values for these HMA properties are those from the JMF. JMF values developed from Section 12.2 are the control values. In some situations, the agency may want to require other properties such as moisture content in the HMA or bulk specific gravity of the aggregate.
- 13.1.4. QC testing will be based on samples from individual sublots and lots.
- 13.1.5. In accordance with agency requirements, the contractor should record the quantities of asphalt binder, aggregate, mineral filler, and fibers (if required), as well as the quantities of HMA produced, and the production temperature.
- 13.2. *Quality Control Components:*
- 13.2.1. The QC plan should be contract-specific and state how the contractor proposes to control the materials, equipment, and operations of the project. The agency should specify minimum information for the QC plan such as: personnel, plant operation, HMA transportation, roadway operations, and compaction operations.
- 13.3. *Lots and Sublots for Quality Control:*
- 13.3.1. The QC plan should indicate lot and subplot size for initial production and production lots.
- 13.3.2. Production lots will be based on HMA as delivered to the roadway. Recommended lot will be defined for 19.0-mm nominal maximum aggregate size or larger mixture designs and for 12.5-mm or smaller mixture designs. Lots will be further subdivided into equal sublots not to exceed 1000 Mg (1000 tons) for 19.0-mm or larger mixture designs or 600 Mg (600 tons) for 12.5-mm or smaller mixture designs. Typically, four or more sublots constitute a lot. Partial sublots of 100 Mg (100 tons) or less can be added to the previous subplot. Partial sublots greater than 100 Mg (100 tons) can constitute a full subplot. Lots that contain a single subplot could be combined with the previous lot for acceptance purposes.
- 13.4. *Quality Control Laboratory:*
- 13.4.1. The HMA producer should provide and maintain a laboratory for QC testing. The laboratory should have the necessary space, equipment, and supplies for the tests to be performed. The laboratory testing equipment should meet the requirements of the test methods identified for the required sampling and testing. The agency should have the right to observe all QC testing.
- 13.5. *Test Equipment Calibration:*
- 13.5.1. The test equipment furnished by the contractor should be properly calibrated or verified and maintained in accordance with Appendix X3.2 and [R 18](#).
- 13.6. *Quality Control for Plant Operations:*
- 13.6.1. The contractor should designate the sampling and sample reduction procedures, sampling locations, and size of samples necessary for testing. Sampling should be performed on each subplot. Sample locations should be selected randomly according to Appendix X1. The contractor may select random numbers independent of agency locations or may match the agency locations, but samples should not be split. If contractor tests are to be used for acceptance, Section 14.5 should govern the sampling requirements.
- 13.6.2. The contractor should use QC charts that show test results for critical sieves, asphalt binder content, maximum theoretical specific gravity, air voids, VMA, and VFA to identify variability in

the HMA production. Target values, warning, and action limits should be shown on the same charts. Details regarding QC plans and QC charts are located in Appendix X3.

13.7. *Quality Control for Roadway Operations:*

13.7.1. The contractor should control the HMA placement and compaction process to ensure compliance with the project specifications. Details regarding QC for roadway operations are located in Appendix X3.

13.8. *Documentation:*

13.8.1. The contractor should maintain adequate records of all tests. The records should indicate the test results and the nature of corrective action taken as appropriate. All charts and records documenting the contractor's QC operations and tests should be available to the agency during the performance and upon the completion of the work. The contractor should keep the test results on file for a minimum period of three years following completion of the work.

13.8.2. Test properties for the various materials and mixtures should be charted on forms or other appropriate means in accordance with the applicable requirements of the agency.

13.8.3. If production is terminated in accordance with Appendix X3.4.4 or X3.5.5, the cause and resolution should be documented.

14. HMA ACCEPTANCE PROCEDURES

14.1. *General Requirements:*

14.1.1. Acceptance sampling and testing of HMA involves stratified random sampling that is applied to a series of sublots of HMA. The objective of acceptance testing is to verify that the product meets contract specifications.

14.1.2. The agency will obtain, using the methods required by Section 10, a sample of HMA from each sublot.

14.1.3. HMA properties for acceptance typically include the asphalt binder content, air voids, VMA, and other requirements of the agency. Target values for these HMA properties should be those from the JMF. Acceptance testing also includes density on the roadway.

14.1.4. Acceptance testing will be based on independent samples from the same sublots that are used for QC and, in fact, may include different properties. Lots and sublots will be based on mixture as delivered to the roadway.

14.1.5. The method of acceptance should be statistically based to evaluate the acceptability of the HMA. Statistically based methods, such as percent within limits using standard deviation, should be used. See Appendix X4.

14.2. *Acceptance for Mixture Properties (Air Voids, VMA, Asphalt Content):*

14.2.1. *Point of Sampling*—The agency representative should obtain stratified random acceptance samples in accordance with Section 10.2. The samples should be obtained from the HMA behind the screed prior to initial rolling.

Note 3—If a correlation factor between samples taken from a truck at the plant and samples from the roadway behind the screed has been developed, the sample may be taken from the haul truck at the plant.

- 14.2.2. *Number of Samples*—One sample per subplot in accordance with Section 10.2.2.
- 14.2.3. *Lot Size*—Lots will be defined for 19.0-mm nominal maximum aggregate size or larger mixture designs and for 12.5-mm or smaller mixture designs. Lots will be further subdivided into equal sublots not to exceed 1000 Mg (1000 tons) for 19.0-mm or larger mixture or 600 Mg (600 tons) for 12.5-mm or smaller mixture. Typically, four or more sublots constitute a lot. Partial sublots of 100 Mg (100 tons) or less can be added to the previous subplot. Partial sublots greater than 100 Mg (100 tons) can constitute a full subplot. Lots that contain a single subplot could be combined with the previous lot for acceptance purposes.
- 14.2.4. If a delay of more than four calendar days occurs in any one subplot, a partial subplot should be declared and a new subplot should start when production resumes.
- 14.3. *Acceptance for In-Place Density, Percent Theoretical Maximum Density (% G_{mm}):*
- 14.3.1. *Point of Sampling*—The agency representative should determine stratified random acceptance sample locations in accordance with Section 10.3. The locations should be determined after rolling operations are completed.
- 14.3.2. *Number of Tests*—Two core samples or two nondestructive in-place tests per subplot are used in accordance with Section 10.3.1.
- 14.3.3. *Lot Size*—Lot and subplot sizes are to be the same as the HMA lots and sublots in accordance with Section 14.2.3.
- 14.3.4. *Acceptance Testing*—Obtain cores in accordance with [ASTM D5361/D5361M](#) from each location and transport the cores to a laboratory for testing. From the HMA sample in each subplot, determine the maximum specific gravity (G_{mm}). For each core, measure the bulk specific gravity (G_{mb}) in accordance with [T 166](#), and calculate density as a percent of theoretical maximum density (% G_{mm}). Alternately, if the variability of test results is acceptable to the agency, a calibrated nuclear density gauge can be used to determine the bulk specific gravity at each location, in accordance with [ASTM D2950/D2950M](#), and used to calculate density as a percent of theoretical maximum density (% G_{mm}).
- 14.4. *Acceptance Process:*
- 14.4.1. The agency will determine acceptable quality limits for HMA properties and in-place density.
- 14.4.2. Smoothness is also an important acceptance property. The agency should select a method of measuring smoothness (e.g., rolling straightedge, lightweight or high-speed profilometers) and will develop specific acceptance criteria.
- 14.4.3. The agency may also use subjective measures such as segregation to determine the acceptability of the HMA. The agency may add specific criteria that may not be statistically based.
- 14.5. *Contractor Tests Used in the Acceptance Decision:*
- 14.5.1. The use of contractor tests for project acceptance is permitted when the agency has developed an Acceptance Program in accordance with Section 14.1.5 that includes independent verification and statistical evaluation of the contractor's test results. Contractor and agency sample locations will be selected independently.
- 14.5.2. The contractor should maintain an acceptance testing program that includes the use of a qualified laboratory and qualified testing personnel, established material sampling frequencies and testing

protocols, and reporting procedures. Contractor acceptance samples should be taken from the same point of sampling as used by the agency.

- 14.5.3. The agency should establish a verification sampling and testing program that includes testing of materials by a qualified laboratory and qualified testing personnel on samples taken independently of the contractor's acceptance tests but within the same production period, quantity, area, etc. as the contractor's tests.
- 14.5.4. The agency should develop a statistical method of comparing the contractor's acceptance and the agency's verification tests to verify the contractor's acceptance test results, such as a comparison of means and standard deviations.
- 14.5.5. The agency should develop a dispute resolution system in accordance with Section 15 that addresses the disposition of discrepancies occurring between the contractor acceptance and the agency verification tests.
- 14.5.6. The agency's independent assurance program should include the evaluation of the contractor's qualified laboratory and qualified testing personnel.
- 14.6. *Pay Factors:*
- 14.6.1. The agency should develop a table of pay factors, pay equations, or pay curves based on the method of acceptance.
- 14.7. *Documentation:*
- 14.7.1. The agency should maintain adequate records of all acceptance tests. The records should indicate the test results and the acceptance decisions.
- 14.7.2. Contractor test results that are used for acceptance should be available to the agency during the performance of the work. Test results should be submitted to the agency on forms or other appropriate means in accordance with agency requirements.

15. DISPUTE RESOLUTION

- 15.1. The agency should establish procedures for addressing tests that do not meet the required specification limits, for identifying dissimilar test results, for providing backup samples, and for resolving differences.
- 15.1.1. The definition of dissimilar is typically based on the difference between reported values for split samples as related to the number of standard deviations (d2s) for the test. The agency should use AASHTO or ASTM test procedures to determine the range of allowable results between two laboratories. Other valid procedures include statistical tests that compare means and variability of the acceptance and verification tests results.
- 15.1.2. The specification should indicate the process by which a backup sample will be taken. Backup samples should be taken at the same time as the original sample.
- 15.1.3. The dispute resolution process should address the length of time during which an appeal can be made, who will do testing on backup samples, and how the retest values will be used to resolve the dispute.