

Quality Control Manual for Hot Mix Asphalt Using Statistical Pay Factors



DEPARTMENT OF
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Division of
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Please send comments or suggestions regarding this manual to:

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PREFACE

Caltrans implemented the Quality Control Quality Assurance (QCQA) specifications for hot mix asphalt in 1995. The QCQA specifications provided incentives and disincentives based on a statistical analysis of the contractor's verified test data. In 2014, Caltrans made the switch from the Hveem mix design process to the Superpave mix design process and temporarily removed the incentive and disincentive specifications. In 2019, after five years of continuous improvement to the Superpave mix design specifications, the incentive and disincentive specifications were re-implemented as "Hot Mix Asphalt Using Statistical Pay Factors (SPF)."

The new specifications are similar to the previous QCQA specifications, except that a pay factor for air voids replaces a pay factor of one of the aggregate gradation sieve sizes. Additionally, the contractor performs quality-control testing using a density gauge (nuclear or non-nuclear), followed by determining actual in-place density using cores. The California Department of Transportation (Caltrans) continues to monitor and perform its own verification testing before using the contractor's test results for acceptance and payment. Caltrans testing is no longer referred to as quality assurance testing, because the specifications define quality assurance as covering both the contractor's quality control testing and Caltrans' acceptance and verification testing.

The Statistical Pay Factor specifications, Section 39-2.09 "Type A Hot Mix Asphalt using Statistical Pay Factors," and 39-2.10, "Rubberized Hot Mix Asphalt Gap-Graded Using Statistical Pay Factors," will be added as a special provision in each contract prior to being incorporated into the *Standard Specifications*. Like the old QCQA specifications, the new SPF specifications have the following goals:

- Improve the quality of materials and processes used in the construction of highway projects and reduce the life-cycle costs for the facilities involved
- Place responsibility for quality control on the contractor
- Reduce disputes between contractors and Caltrans

The hot mix asphalt using statistical pay factor specifications were developed to emphasize quality control during the production and placement of material. Hot mix asphalt acceptance and payment are based on:

- The contractor's fulfillment of quality-control inspection, sampling, and testing.
- The resident engineer's inspection, sampling, and testing to verify that the contractor's quality-control inspection, sampling, and testing comply with specifications.
- Statistical evaluation of specified quality characteristics.

The objective of the *Quality Control Manual for Hot Mix Asphalt using Statistical Pay Factors* is to help the contractor fulfill the quality-control responsibilities for hot mix asphalt projects that require the SPF construction process.

INTRODUCTION

The contractor is responsible for quality throughout hot mix asphalt (HMA) production and placement. Therefore, the contractor must verify that the materials provided and work performed by subcontractors, suppliers, and producers comply with project specifications. The contractor provides the necessary quality control so that materials comply with specifications.

Following are the major components of the SPF quality control program:

- Quality control
- Verification
- Independent assurance
- Dispute resolution
- Acceptance and payment

Figure 1 is a flowchart of the major components of the SPF quality-control program and their relationships.

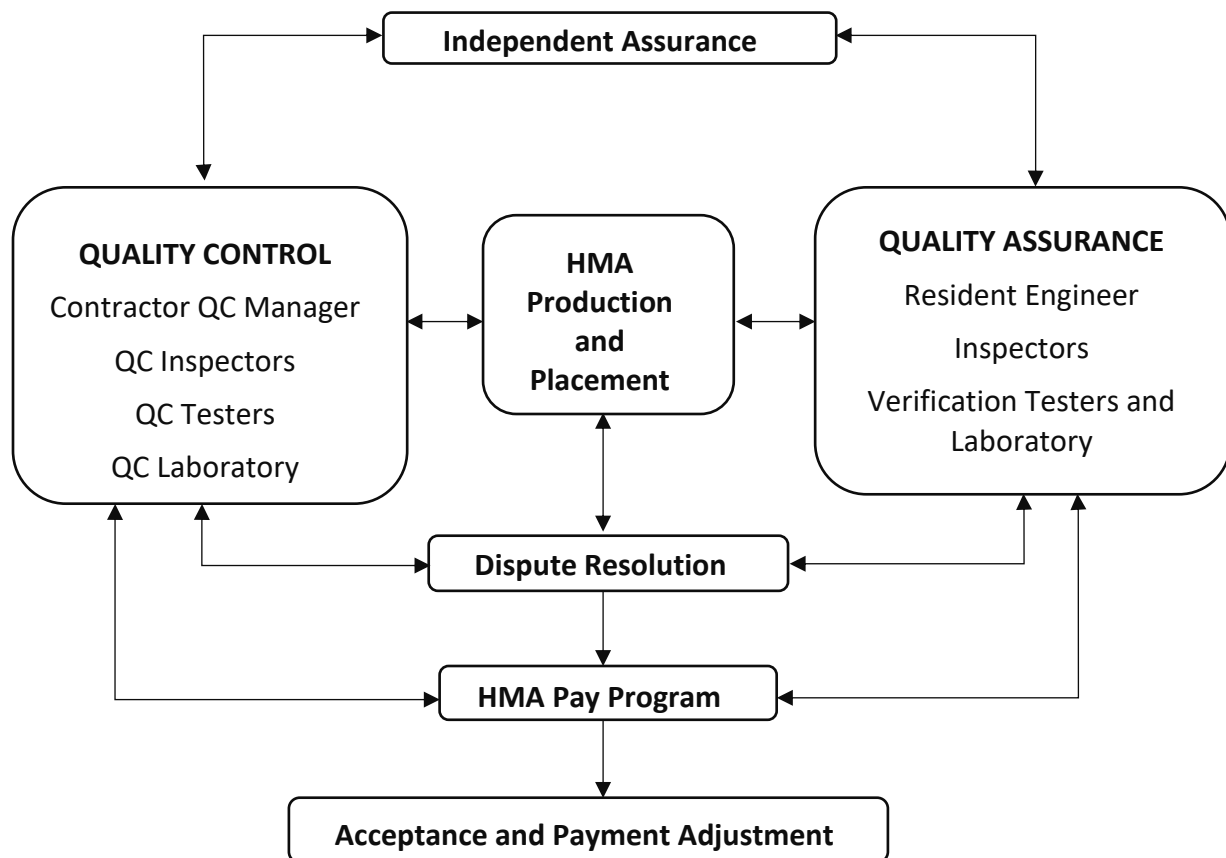


Figure 1. SPF Program Components and Relationships

QUALITY CONTROL PLAN

The contractor is responsible for developing and implementing a quality-control plan for inspection, testing, and other specified actions so that all aspects of hot mix asphalt production and placement meet specifications. A quality control plan must address contractor process monitoring including inspection, sampling, and testing. Process monitoring has action limits and specified steps to be taken if the action limits are breached. The specified steps are taken for the following reasons:

- To keep the process in control
- To quickly determine when the process has gone out of control
- To respond adequately to correct the situation and bring the process back into control

General Requirements

The contractor must submit a project-specific quality-control plan to the resident engineer for acceptance. The contractor's quality-control plan submittal letter should briefly describe key elements of the plan that have been developed to fulfill the contract requirements. The submittal letter should identify the contractor, hot mix asphalt paving subcontractor, if applicable, hot mix asphalt producer, and quality control manager. If hot mix asphalt production and placement are subcontracted, the quality control manager may report to the subcontractor if the contractor has so delegated in the letter of submittal for the quality-control plan. Appendix A shows a sample quality control plan submittal letter.

The resident engineer uses the quality-control plan minimum requirements outlined in this manual to evaluate the plan for acceptance. If the resident engineer does not accept the quality-control plan, the contractor submits a revised plan. Each page of a revised plan indicates the revision number and date. The resident engineer has five business days to review each submitted quality-control plan. The contractor cannot begin hot mix asphalt production and placement without the resident engineer's acceptance of the quality-control plan.

During work progress, the contractor must submit in writing to the resident engineer quality-control plan supplements for changes to quality-control procedures, personnel, tester qualification status, or laboratory accreditation. The contractor must retain copies of all documents for three years after final contract acceptance.

Elements

At a minimum, the quality control-plan must include the following elements:

- Quality control plan certification by the quality-control manager
- Quality-control organization
- Quality-control plan distribution list
- Quality-control inspection plans
- Sampling and testing plan

- Random sampling plan
- Laboratories and equipment
- Action limits and corrective action plans
- Quality-control documents

Certification

The quality-control manager must certify that the plan developed for a project meets the requirements of the contract specifications and this manual. The manager must review the qualifications of proposed quality-control personnel and verify that proposed samplers, testers, and laboratories meet the requirements of the Caltrans Independent Assurance Program.

Tester certifications and laboratory accreditations can be verified through the Statewide Independent Assurance Database:

<https://sia.dot.ca.gov/>

The quality -control plan cover must contain a signed statement by the quality-control manager:

It is hereby certified that the information contained in this quality-control plan for contract *[insert contract number]* meets the requirements of contract specifications and the *Quality Control Manual for Hot Mix Asphalt Using Statistical Pay Factors*. This quality-control plan identifies qualified testing personnel and accredited laboratories in accordance with the *Independent Assurance Manual*.

Appendix B shows a sample quality-control plan cover letter with the quality-control manager certification statement.

Organization

The quality-control plan must include the contractor's quality-control organization for the project. The organization must, at a minimum, identify the following: quality-control manager, inspectors, samplers, testers, and laboratories. The organization section must provide the following information:

- Quality-control organization chart
- Quality-control manager's qualifications and experience
- Request for assignment of inspectors, samplers, and testers
- Quality-control inspector affidavit of proficiency
- Sampler and tester qualification certificates of proficiency
- Laboratory accreditation

The following table outlines minimum numbers of field quality-control staff for hot mix asphalt production and placement:

Field Compaction Requirement	Quality Control Staffing Levels (excluding the manager) (see Note 3)
Method Compaction	3 (see Note 1)
Density Testing	4 (see Note 2)

Note 1 One hot mix asphalt inspector at the plant, one at the site of placement, a third where the contractor deems necessary.

Note 2 One hot mix asphalt inspector at the plant, one at the site of placement performing density testing, one additional at the site of placement, and a fourth where the contractor deems necessary.

Note 3 The contractor must provide a qualified sampler to pull the engineer’s verification samples of hot mix asphalt and density cores. The contractor must split the hot mix asphalt sample into four parts, provide three to the engineer, and keep one. This person may be one of the three required for method compaction, or one of the four required for projects with density testing. The contractor’s portion of the splits may not be used as quality-control sample.

The organizational chart must show the contractor and each subcontractor laboratory, and it must identify all quality-control staff involved in hot mix asphalt production, placement, or evaluation. The chart must show how these organizations and personnel will interconnect and communicate. Appendix C shows a sample quality control organization chart. The chart must show the following:

- Reporting hierarchy of quality-control organization, contractor, subcontractors, and hot mix asphalt producers
- All quality-control staff by name and function
- The primary and secondary person for each function
- The contact phone numbers and email addresses for all quality-control staff
- The name, contact name, and telephone number of each quality-control laboratory
- When the contractor is using a testing laboratory independent of the quality-control testing laboratory to confirm quality-control testing, the name, contact name, and telephone number of the independent testing laboratory
- The roles and responsibilities for staff and laboratories

Success of the contractor’s quality-control program requires the quality-control manager, inspectors, samplers, laboratories, and testers to act as a team to accomplish desired results.

The contractor must assure that adequate communication exists among quality-control staff and production and placement staff at all locations.

Quality-control manager—The quality-control manager must be an employee of the contractor, the hot mix asphalt production or placement subcontractor, or a consultant employed by the contractor. The manager must be at the job site within 3 hours of receiving notice. The manager must not report to those responsible for the construction and production operations and cannot perform other quality-control functions, such as hot mix asphalt inspection, sampling, or testing. The manager provides training to the contractor, subcontractor, producer, and quality-control personnel. The contractor may assign an alternate quality-control manager. The alternate must be qualified and authorized to perform quality-control manager functions as described in this manual.

The quality-control manager must have previous quality-control experience on a project of comparable size and scope and previous statistical pay factor quality control program training. The quality-control plan must include the manager’s name, qualifications, and experience. See Appendix D for sample qualifications and experience.

The quality-control manager is responsible for administering the quality-control program, including preparing the quality-control plan, and reviewing test results, inspection reports, material certificates, and production processes to assure that all materials and completed hot mix asphalt pavement conform to contract requirements. The quality-control manager must indicate review of quality-control documents, including test reports and inspection reports, by initialing each document. The quality-control manager must have full authority to institute actions necessary for a successful quality-control program to assure that hot mix asphalt complies with the specifications.

The manager must prepare and submit quality-control plan supplements to the contractor when there are changes to quality-control procedures, personnel, tester qualification status, or laboratory accreditation. The contractor submits the supplements to the resident engineer. The manager must assure that quality-control plan supplements are immediately distributed.

Quality-control inspectors—The contractor is responsible for inspecting the production, transportation, placement, and compacting operations of hot mix asphalt and the finished roadway surface. As representatives of the contractor, the quality-control inspectors are responsible for inspection of hot mix asphalt production and placement to assure compliance with the specifications. Inspectors must be familiar with:

- Plans
- *Standard Specifications*
- Special provisions
- Hot mix asphalt production and placement operations
- Potential problem areas

- Inspection documentation requirements

The hot mix asphalt quality-control inspectors should have inspection experience on projects of similar type and size and have attended some hot mix asphalt training. The quality-control manager certifies and submits the hot mix asphalt production and hot mix asphalt placement inspectors' qualifications on Form CEM-3802, "Quality Control Inspector Affidavit of Proficiency." The quality-control manager includes the names of proposed quality-control inspectors on Form CEM-3801, "Request for Assignment of Inspectors, Samplers, and Testers."

Forms can be found at:

<http://cefs2.dot.ca.gov/>

Hot mix asphalt production and placement inspectors, when qualified by the Caltrans Independent Assurance Program (IAP) for California Test 125, "Methods of Test for Sampling Highway Materials and Products Used in Roadway Structural Section," may obtain aggregate or hot mix asphalt samples at the hot mix asphalt production facility. Inspectors who may perform sampling must have both the box for inspection and for sampling checked on Form CEM-3801 with Form TL-0111, "Qualified Certificate of Proficiency," attached. Both forms are shown in Appendix E.

Quality-control samplers and testers—The contractor is responsible for sampling and testing aggregates and hot mix asphalt mix. Samplers and testers must be familiar with sampling and testing requirements of the quality-control plan, procedures for sampling and testing, proper care of materials samples and testing equipment, and sampling and testing documentation requirements.

The Caltrans IAP must qualify all samplers and testers who perform quality-control sampling and testing. It is the contractor's responsibility to verify that all samplers and testers maintain a current qualification, as shown on Form TL-0111, for the test methods required for hot mix asphalt.

The quality-control manager must include samplers' and testers' names on Form CEM-3801 with a copy of a current TL-0111 for each sampler and tester named. Tester certifications and laboratory accreditations can be verified through the Statewide Independent Assurance Database.

Quality control laboratories—The contractor is responsible for providing adequate laboratory facilities to fulfill the specified testing requirements and quality-control needs for production and placement of hot mix asphalt. Quality-control laboratory personnel must be qualified by the Caltrans IAP and have in-depth knowledge of the project quality-control plan. Where required, the Caltrans IAP must inspect and accredit quality-control laboratories. Copies of the current Caltrans IAP accreditation, Appendix E, for each quality-control laboratory must be included in the quality-control plan. See the "Laboratories and Equipment" section of this manual for more information about quality-control laboratory requirements.

Distribution

The contractor develops a quality-control plan distribution list that must include:

- Individuals and locations to receive the quality-control plan (quality-control manager, resident engineer, paving foreperson, inspectors, samplers, testers, hot mix asphalt production facility, laboratories, aggregate suppliers, and HMA transportation providers).
- The person responsible for distributing the quality control plan and its supplements.

Inspection Plans

The contractor is responsible for inspecting the production, transportation, placement, and compaction of hot mix asphalt and the finished roadway surface. The quality-control plan must include an outline of planned inspections and list HMA inspectors' duties for the production facility and roadway. A sample HMA production inspection plan is shown in Appendix F, and a sample HMA placement inspection plan is shown in Appendix G.

All inspectors must be familiar with the reporting forms used to record their daily activities. They must complete these records each day and submit them to the quality-control manager for review. The manager must, in turn, compile all daily records of inspection and submit them with a summary report to the resident engineer. The reporting form for HMA production inspection is Form CEM-3501, "Hot Mix Asphalt Production Report," and the reporting form for HMA placement inspection is Form CEM-3502, "Hot Mix Asphalt Placement Report."

The contractor's quality-control inspection plans must address, at a minimum, the following requirements for HMA production inspection and placement inspection.

Hot Mix Asphalt Production Inspection

Before the first day of HMA production, the production inspector must verify that the requirements are met for plant qualification and moisture sensitivity treatment of aggregates.

Hot Mix Asphalt Plant Qualification

Hot mix asphalt plants must be qualified under the Caltrans Materials Plant Quality Program.

Before production begins, the HMA production inspector takes the following steps:

- Verify with the Caltrans district weights and measures coordinator that the proposed HMA plant is Caltrans-qualified under the Material Plant Quality Program. Batch HMA plants must be qualified annually, and continuous HMA plants are qualified at least every six months, in accordance with "MPQP Frequency" of the *Material Plan Quality Program* manual.
- If plant is not qualified, notify the quality control manager.
- If applicable, accept HMA from a non-qualified plant if a "Startup Approval" letter (completion of dynamic testing not to exceed 14 days) has been granted by the district weights and measures coordinator.

Moisture Sensitivity Treatment

The HMA may be sensitive to moisture damage and require one of the following antistripping treatments, to be identified on Form CEM-3511, “Contractor Job Mix Formula Proposal.”

HMA aggregate lime treatment—slurry method

HMA aggregate lime treatment—dry lime method

Liquid antistripping treatment

Lime Treatment of Aggregates

Lime treatment of aggregates has two processes:

- HMA aggregate lime treatment—slurry method
- HMA aggregate lime treatment—dry lime method

Quality-control test limits for aggregate properties were established without lime treatment, so aggregate testing must be performed before lime treatment.

Before production begins, verify with the Caltrans district weights and measures coordinator that the proposed lime plant is Caltrans-qualified under the Material Plant Quality Program.

During lime treatment of aggregates, verify that:

- Aggregate samples for sand equivalent, gradation, and moisture content are taken at the frequency shown in the Quality Control Sampling and Testing Plan. Sample aggregate from stockpiles in accordance with California Test 125, “Method of Test for Sampling Highway Materials and Products Used in Roadway Structural Sections.”
- Aggregate samples for sand equivalent and gradation are tested at the frequency shown in the Quality Control Sampling and Testing Plan. Combine aggregate from individual stockpiles in the job mix formula (JMF) proportions as necessary for testing.
- Aggregate samples are tested for moisture content in accordance with AASHTO T 255, “Method of Test for Total Evaporable Moisture Content of Aggregate by Drying.” Notify the contractor of the test results, and confirm that any required plant adjustment has been made.
- Aggregate samples for aggregate quality characteristic testing are obtained from stockpiles in accordance with California Test 125 and at the frequency shown in the Quality Control Sampling and Testing Plan. Verify that aggregate samples are tested for aggregate properties including:
 1. Los Angeles Rattler
 2. Percent of crushed particles coarse aggregate (one-fractured face)
 3. Percent of crushed particles coarse aggregate (two fractured faces)
 4. Percent of crushed particles fine aggregate (one fractured face)

5. Fine aggregate angularity
 6. Flat and elongated particles
 7. Other aggregate properties specified in the project special provisions, if applicable
- For slurry method and dry lime method, assure that aggregate treatment is adequate by witnessing plant operation and verify that the data is entered by the contractor into the treatment data log as required by the specifications.

For each day of aggregate lime treatment, obtain the treatment data log in tab-delimited format on a data storage device. Provide the quality-control manager with the lime treatment data for submittal to the resident engineer.

Liquid Antistrip Treatment

This treatment process requires the treatment of the asphalt binder with liquid antistrip. Before production begins, the hot mix asphalt production inspector takes the following steps related to liquid antistrip treatment:

- Verify with the Caltrans district weights and measures coordinator that the proposed antistrip metering device and storage tank are Caltrans-qualified under the Material Plant Quality Program.
- Verify that the liquid antistrip is the same type and brand as shown on the accepted JMF.

During antistrip treatment of aggregates, witness the contractor recording the liquid antistrip treatment data into treatment data log as required by the specifications.

For each day of antistrip treatment, obtain the treatment data log in print and electronic media in tab-delimited format. Provide the quality-control manager with the antistrip data for submittal to resident engineer.

Inspection Requirements Before Daily Start of Production

The HMA production inspector must be familiar with the HMA production facility to be inspected. The inspectors must document each day's production information on Form CEM-3501, "Hot Mix Asphalt Production Report." CEM forms are available at:

<http://cefs2.dot.ca.gov/>

Before daily start of production, HMA production inspection requires:

- Recording plant inspection information on Form CEM-3501 to document compliance with the specifications.
- Verifying that aggregate is stored separately according to the specified sizes. For proper storage of specified sizes, compare the material from each bin with requirements in "Aggregate Storage" of the *Material Plant Quality Program* manual. If any segregation, degradation, or intermingling occurs, require the contractor to empty the storage facility and to waste or re-screen the material.

- Assuring that the supplemental fine aggregate remains dry and is stored separately as specified in *Material Plant Quality Program* manual.
- Verifying that the security seal has not been tampered with.
- Checking that the proportioning equipment is interlocked as specified in the *Material Plant Quality Program* manual.
- Verifying that the JMF, unmodified or modified in accordance with 39-2.01A(3)(b)(iii), “Job Mix Formula Modification,” of the *Standard Specifications*, being used by the contractor has been verified and authorized for the project and that no changes have been made to:
 1. Target asphalt binder percentage.
 2. Asphalt binder supplier.
 3. Asphalt rubber binder supplier.
 4. Component materials used in asphalt rubber binder or percentage of any component material.
 5. Combined aggregate gradation.
 6. Aggregate sources.
 7. Substitution rate for reclaimed asphalt pavement aggregate of more than 5 percent.
 8. Any material in the JMF. Notify the quality-control manger if there has been any change in the JMF.

Verifying that the asphalt binder supplier is on the Caltrans-approved supplier list or that asphalt binder samples have been taken from each truckload and tested in accordance with Section Q, “Requirements for Suppliers Supplying Asphalt Without a Certificate of Compliance,” of the Certificate Program for Suppliers of Asphalt. Immediately notify the contractor and quality-control manager if asphalt binder testing has not been completed for a supplier not on the approved supplier list.

Inspection Requirements During Production

HMA production inspection during production requires the following:

- Recording daily production information on Form CEM-3501, “Hot Mix Asphalt Production Report.” Document additional information about plant production, including instructions from the contractor’s quality-control inspector to the contractor’s personnel.
- Observing the overall plant operation to verify that the contractor controls dust or smoke as specified.
- During the production start-up evaluation, checking that samples of aggregate, asphalt binder, reclaimed asphalt pavement, if applicable, and HMA are obtained within the first 750 tons of HMA production according to Section 39-2.01A(4)(h)(v), “Production Start-up Evaluation,” of the *Standard Specifications*. Sample according to California Test 125 and

provide 3 split samples to the resident engineer and keep 1 part.

- Ensuring that the production start-up evaluation aggregate sample for aggregate gradation and sand equivalent are tested immediately. If reclaimed asphalt pavement is used, determine aggregate gradation according to California Test 384, “Method of Test for Combining Gradations for Hot Mix Asphalt (HMA) using Reclaimed Asphalt Pavement (RAP) and/or Reclaimed Asphalt Shingles (RAS).”
- For continuous mixing plants, verifying that aggregate samples are obtained at least twice a day for aggregate moisture content testing according to AASHTO T 255, “Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying.”
- Assuring that aggregate samples are tested for moisture content according to AASHTO T 255, notifying the contractor of the aggregate moisture test results, and confirming that any required plant adjustment has been made.
- If applicable, obtaining reclaimed asphalt pavement samples for moisture content at least twice a day using California Test 384.
- Ensuring that reclaimed asphalt pavement samples are tested for moisture content using AASHTO T 255, notifying the contractor of the reclaimed asphalt pavement moisture test results, and confirming that any required plant adjustment has been made.
- Ensuring that aggregate samples for aggregate grading and sand equivalent testing are obtained at the frequency shown in the Quality Control Sampling and Testing Plan. Sampling aggregate according to California Test 125, “Methods of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections.” If applicable, taking aggregate samples before lime treatment for testing sand equivalent. Reclaimed asphalt pavement does not need to be sampled for aggregate gradation or sand equivalent.
- Making sure that aggregate samples for aggregate gradation and sand equivalent are tested at the frequency shown in the Quality Control Sampling and Testing Plan. If reclaimed asphalt pavement is used, determine aggregate gradation using California Test 384. Notifying the contractor of aggregate gradation and sand equivalent test results, and confirming that any required plant adjustment has been made to correct for out-of-action limit aggregate gradation.
- Assuring that aggregate samples are obtained according to California Test 125 at the frequency shown in the Quality Control Sampling and Testing Plan for testing aggregate properties including:
 1. Los Angeles Rattler
 2. Percent of crushed particles coarse aggregate (one fractured face)
 3. Percent of crushed particles coarse aggregate (two fractured faces)
 4. Percent of crushed particles fine aggregate (one fractured face)

5. Fine aggregate angularity
 6. Flat and elongated particles
 7. Other aggregate properties specified in the project special provisions. If applicable, aggregate samples must be taken before lime treatment for testing aggregate properties. Reclaimed asphalt pavement does not need to be sampled for aggregate properties.
- Obtaining the required certificates of compliance; see Section 92-1.01D(2), “Certification,” of the *Standard Specifications*, for all loads of asphalt binder and providing them to the quality-control manager for submittal to the resident engineer.
 - Ensuring that a sample of asphalt binder is obtained and submitted to the resident engineer. Sampling the asphalt binder at the frequency shown in the Quality Control Sampling and Testing Plan.
 - Ensuring that asphalt rubber binder:
 1. Complies with the specifications by witnessing the contractor measure asphalt rubber binder viscosity using ASTM D7741, “Standard Test Method for Measurement of Apparent Viscosity of Asphalt-Rubber or Other Asphalt Binders by Using a Rotational Handheld Viscometer.”
 2. Is not used during the first 45 minutes of the reaction period.
 3. Is not reheated more than twice.
 4. Is measured hourly by the contractor for temperature and viscosity and provided in daily logs.

For asphalt rubber binder components:

1. Collect certificates of compliance for each truckload of crumb rubber modifier and asphalt modifier.
 2. Collect a “Buy America” certificate for each truckload of crumb rubber modifier.
 3. Obtain samples of crumb rubber modifier using California Test 385, “Method of Test for Crumb Rubber Modifier,” and at the frequency shown in the Quality Control Sampling and Testing Plan. Provide the samples to the resident engineer.
 4. Obtain samples of asphalt modifier and provide them to the resident engineer. Sample asphalt modifier binder at the frequencies shown in the Quality Control Sampling and Testing Plan.
- For HMA that uses asphalt binder containing crumb rubber modifier, verify that Form CEM-4410, “Crumb Rubber Usage Report,” is submitted monthly and at the end of the project.
 - Except for smoothness, if two consecutive non-pay factor quality characteristic test results or any 3 quality characteristics (pay factor or non-pay factor quality characteristics) for 1

day's production do not comply with the specifications, make sure the contractor stops HMA production, notifies the resident engineer, takes corrective action, and demonstrates compliance with the specifications before resuming production and placement of HMA on the project.

- Check that the temperatures of the asphalt binder, aggregate, and HMA mixture are within limits specified in Section 39-2.01B(8), "Hot Mix Asphalt Production," of the *Standard Specifications*. Record temperatures and times taken in the daily HMA production report.
- Verify that the batch size and feed rates do not exceed the mixing capacity range used during plant dynamic testing conducted in accordance with the *Material Plant Quality Program* manual.
- Check that samples of HMA mixture for mix moisture are obtained according to California Test 125, "Methods of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections," at the frequency shown in the Quality Control Sampling and Testing Plan.
- Make sure that samples of HMA mixture are tested to determine HMA mix moisture in accordance with AASHTO T 329, "Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method," and at the frequency shown in the Quality Control Sampling and Testing Plan.
- For batch plants:
 1. Observe production to assure that the mixing time and sequence of withdrawal from the bins produce the specified homogeneous hot mix asphalt mixture.
 2. Observe that the automatic batching equipment functions within limits specified in "Hot Mix Asphalt Plant Equipment" of *Material Plant Quality Program* manual.

For continuous mixing plants (dryer drum or dryer drum pugmill), verify that the following are operating properly:

1. Vibrating unit on the fine bins
 2. Low-level and no-flow interlock systems for aggregate and reclaimed asphalt pavement feeder bins
 3. No-flow interlock system for asphalt binder storage and feed system
 4. Automatic plant controller
 5. Dust control systems
 6. Segregation devices at hot mix asphalt storage
- Observe the operation of all weighing systems. Whenever scales and meters seem inaccurate, contact the district weights and measures coordinator for further assistance. Be aware of scale and meter security seals and set points.
 - For batch plants, make sure that the equipment is operating properly:

1. For the batching process, consider the weight of the material falling from the bin gates to the weighing hopper after the gates are closed (in-air weight compensation).
 2. Verify that the weigh box containing the total batch does not contact anything that prevents a true indication of the batch weight.
 3. When intermediate storage (silo) of hot mix asphalt does not occur, periodically check the batching by comparing the total weight of the batches in a truckload with the platform scale weight for the same load.
 4. Check the asphalt binder scales frequently to verify that they return to within zero tolerance limits and that the scale lever systems or load cells move freely.
- For HMA storage in silos that complies with “Hot Mix Asphalt Storage,” of *Material Plant Quality Program* manual, verify that HMA storage:
 1. Does not cause obvious segregation.
 2. Maintains specified temperature.
 3. Maintains the minimum silo level.
 4. Does not exceed the maximum storage time.
 - Before trucks are loaded, verify there are no pools of parting agents or other contaminating materials inside. Diesel or other petroleum-based products are prohibited from use as parting agents.
 - After trucks are loaded with HMA mixture, check that aggregate is coated with asphalt binder and the load is not segregated. Notify the contractor and quality-control manager if loads need to be rejected based on non-homogeneous HMA mixture.
 - Make sure loads in trucks are covered with tarpaulins if required by the specifications. If trucks are being tarped, record data on Form CEM-3501, “Hot Mix Asphalt Production Report.”

Hot Mix Asphalt Placement Inspection

For HMA placement operations, one or more inspectors must always be present at the site of placement. The placement inspector documents the data on Form CEM-3502, “Hot Mix Asphalt Placement Report.”

Before Hot Mix Asphalt Placement

To assure that the subgrade has been prepared for HMA placement, the subgrade must be inspected by Caltrans as well as by the contractor’s quality-control placement inspector. Inspect the subgrade before HMA placement to:

- Verify that the subgrade is dry, stable, compacted, and smooth. The subgrade to receive HMA must comply with compaction and elevation tolerance specifications for the material involved. Report any subgrade problems to the contractor and quality control manager.

- Make sure the existing pavement surface is clean. The contractor may use any means, including flushing and sweeping, to remove loose paving particles, dirt, and other extraneous material.
- Make sure the pavement surface is dry and thawed before application of tack coat and paving.
- Verify that the contractor submits calculations for the minimum tack spray rate required to achieve the minimum residual rate required by 39-2.01A(3)(j), “Tack Coat” of the *Standard Specifications* and the contractor’s proposed spray rate.

During Hot Mix Asphalt Placement

As guidance for best practices for HMA placement, refer to “Placing Hot-Mix Asphalt” in *Construction of Hot-Mix Asphalt Pavements* published by the Asphalt Institute. Inspection during HMA placement requires the following:

- Recording daily HMA placement information on Form CEM-3502, “Hot Mix Asphalt Placement Record,” and documenting additional information about HMA placement, including instructions from the contractor’s quality-control inspector to the contractor’s personnel.
- Prior to applying tack coat, per 39-2.01A(3)(j), “Tack Coat” of the *Standard Specifications*, verifying that the contractor submits calculations for the minimum spray rate required to achieve the minimum residual rate.
- Ensuring that tack coat is applied to surfaces to be paved. For guidelines for inspecting tack coat, including determining residual rates, refer to either *Tack Coat Guidelines* manual, or use the “Minimum Tack Coat Spray Rates” table published by Caltrans at:

<https://dot.ca.gov/programs/construction/publications>

On the first day of production and during the first 750 tons of production, ensuring that HMA mix is sampled according to Section 39-2.01A(4)(h)(v), “Production Start-Up Evaluation,” of the *Standard Specifications*. Sample according to California Test 125, “Methods of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections,” and provide the resident engineer with three split samples.

- Ensuring that the HMA production startup evaluation sample is tested for compliance with the specifications for the quality characteristics specified in Sections 39-2.09A(4)(a)(i), “Job Mix Formula and Production Start Up Evaluation” and 39-2.10A(4)(i), “Job Mix Formula and Production Start Up Evaluation” of the *Standard Specifications*, which respectively include the requirements for Type A HMA and RHMA-G. If applicable, assuring that an adequate material sample is obtained for AASHTO T 324 (Modified) “Hamburg Wheel-Track Testing of Compacted Hot-Mix Asphalt (HMA)” and AASHTO T 283 “Resistance of Compacted Asphalt Mixture to Moisture-Induced Damage.”
- Verifying that when HMA compaction is done by method process, HMA placement occurs

within the specified temperature ranges by taking sufficient measurements of the atmosphere, pavement, and HMA mixture, which is not to exceed 325 degrees Fahrenheit. Refer to Section 39- 2.02C “Construction,” for Type A HMA or Section 39-2.03C “Construction” for RHMA-G, of the *Standard Specifications* for atmospheric and surface temperature minimum requirements. Record temperatures and the times taken on Form CEM-3502, “Hot Mix Asphalt Placement Record.” When temperatures are below specified limits, notify the contractor to stop HMA placement.

- Making sure that when HMA is placed against the edge of a longitudinal or transverse construction joint that is damaged or not placed in a neat line, extraneous material is removed by sawcutting or grinding the pavement straight and vertical along the joint.
- Verifying that longitudinal joints between layers are offset 0.5 foot and finished surfaces correspond to the edge of traffic lanes.
- Checking that samples of hot mix asphalt mix are obtained in accordance with California Test 125, “Methods of Test for Sampling Highway Materials and Products Used in the Roadway Structural Sections” at the frequency shown in the Quality Control Sampling and Testing Plan.
- Making sure that the contractor quality control samples and the engineer verification samples are independent of each other.
- Making sure that aggregates samples are tested at the frequency shown in the Quality Control Sampling and Testing Plan for:
 1. Gradation (AASHTO T 27), “Sieve Analysis of Fine and Coarse Aggregate”
 2. Sand equivalent (AASHTO T 176), “Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test”
 3. Moisture content (AASHTO T 255), “Total Evaporable Moisture Content of Aggregate by Drying”
 4. Crushed particles (AASHTO T 335), “Determining the Percentage of Fracture in Coarse Aggregate”
 5. Los Angeles Rattler (AASHTO T 96), “Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine”
 6. Flat and elongated particles (ASTM D4791), “Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate”
 7. Fine aggregate angularity (AASHTO T 304, Method A), “Uncompacted Void Content of Fine Aggregate”
- Checking that reclaimed asphalt pavement (RAP) samples, if shown in the job mix formula, are tested at the frequency shown in the Quality Control Sampling and Testing Plan for:
 1. Asphalt binder content of RAP (AASHTO T 164), “Quantitative Extraction of Asphalt

Binder from Hot Mix Asphalt (HMA)”

2. Aggregate gradation of RAP (California Test 384), “Method of Test for Combining Gradations for Hot Mix Asphalt Using Reclaimed Asphalt Pavement (RAP) and/or Reclaimed Asphalt Shingles (RAS)”
 3. Moisture content of RAP
- Assuring that hot mix asphalt samples are tested at the frequency shown in Quality Control Sampling and Testing Plan for:
 1. Asphalt binder content (AASHTO T 308, Method A), “Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method”
 2. HMA moisture content (AASHTO T 329), “Moisture Content of Asphalt Mixtures by Oven Method”
 3. Air voids content (AASHTO T 269), “Percent Air Voids in Compacted Dense and Open Asphalt Mixtures”
 4. Dust proportion (Asphalt Institute MS-2), “*Asphalt Mix Design Methods*”
 5. Density of Core (AASHTO T 275, Method A), “Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Paraffin-Coated Specimens”
 6. Theoretical maximum density (AASHTO T 209, Method A), “Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)”
 7. Hamburg wheel track (AASHTO T 324 (Modified)), “Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures”
 8. Moisture susceptibility (AASHTO T 283), “Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage”
 9. Any test specified in the project special provisions and included in the sampling and testing plan.
 10. Nuclear or non-nuclear gauge density as required to monitor in-place density of each subplot during the compaction process. After the compaction is complete, the contractor takes one core per 250 tons, three per subplot. The contractor’s payment and acceptance is based on quality factor determined from the core densities.

If test results for any quality characteristic are beyond the action limits in the quality-control plan, take corrective actions, and document corrective actions in the inspection records.

Except for smoothness, if a single quality characteristic quality-control test is not in compliance with the specifications, make sure the contractor and quality contractor manager are notified.

For quality characteristics with pay factors, once five tests are complete, verify that the individual and composite quality factors are monitored using all tests in the current lot. If the composite quality factor, or any single quality factor for any characteristic except the Number

8 sieve falls below 0.90, or if the quality factor for the Number 8 sieve falls below 0.75, verify that the contractor stops production and placement, notifies the resident engineer, takes corrective action, and demonstrates compliance with the specifications before resuming production and placement of the hot mix asphalt on the project.

Except for smoothness, if any 2 consecutive non-pay factor quality characteristic test results are not in compliance with the specifications, verify that the contractor stops production and placement, notifies the resident engineer, takes corrective action, and demonstrates compliance with the specifications before resuming production and placement of HMA on the project.

Except for smoothness, if any 3 quality characteristic test results are not in compliance in a single day, verify that the contractor stops production and placement, notifies the resident engineer, takes corrective action, and demonstrates compliance with the specifications before resuming production and placement of HMA on the project. When multiple sieves are out of compliance in the same AASHTO T 27 test, they are counted as one failed test. Also:

- Check that HMA delivery trucks have weighmaster certificates and collect them from arriving trucks. If HMA loads are rejected before placement, note on the back of the weighmaster certificate and on the daily Form CEM-3502 why the HMA was rejected, for example: cold mix, segregation, or contamination.
- Verify that the paver performs HMA spreading at the required thickness and that layer thickness does not exceed 0.25 feet when method compaction is required. Compare the HMA spread rate with the theoretical rate, and, if necessary, order the contractor to make adjustments. Check the daily theoretical spread rate against distance actually paved for the day. Indicate the spread rate and layer thickness checks on Form CEM-3502.
- When HMA trucks are queuing, take action to avoid excessive cooling of HMA mixture. If windrowing is used, prevent excessive length of windrow to avoid overcooling of the HMA. Reject material in windrow if extended more than 250 feet in front of the loading equipment or material transfer vehicle.
- Monitor windrow temperatures with an infrared heat gun. Be aware that when using a heat gun, the instrument measures surface temperature only and the interior of the windrow is hotter. When the HMA is run through the paver, the mat temperature may be above the minimum specified.
- Confirm that the rolling pattern and compaction effort determined by the contractor are being met. If the rolling pattern has changed, notify the quality control manager and make a note on Form CEM-3502.
- Make sure that quality-control testing for compaction, the percent of maximum theoretical density, is performed at the frequency shown in Quality Control Sampling and Testing Plan.
- When the method process is used for HMA compaction, make sure compaction equipment

complies with the specifications by verifying that:

1. Specified equipment performs the compaction in the specified order.
2. The required number of coverages is made for each compaction type: first coverage, breakdown, and finish.
3. The HMA compaction is completed above the specified minimum temperature for each compaction type.
4. When a vibratory roller is specified for compaction, its speed in miles per hour must not exceed the vibrations per minute divided by 1,000. When the HMA layer thickness is less than 0.08 foot, the vibrator must be in the off mode.
5. When a pneumatic-tired roller is specified for compaction, the speed does not exceed 5 miles per hour.

Refer to Sections 39-2.01C(2), “Spreading and Compacting Equipment,” and 39-2.01C(15)(b), “Method Compaction” of the *Standard Specifications* for additional compaction equipment requirements and for Type A HMA to Sections 39-2.02C, “Construction,” and for RHMA-G, 39-2.03C, “Construction,” of the *Standard Specifications*, for detailed compaction temperature and coverage requirements. Be sure to:

- Inspect the finished HMA surface for marks, tearing, and irregular texture that may be caused by segregated mix. Notify the contractor of any defective areas.
- Where pavement smoothness using an inertial profiler is not required, obtain pavement smoothness by daily use of a straightedge to determine whether the finished surface complies with the tolerances specified in Section 36-3.01D(4), “Department Acceptance,” of the *Standard Specifications*. Record such measurements on Form CEM-3502, “Hot Mix Asphalt Placement Report,” and notify the contractor and quality-control manager of all out-of-specification areas.

It is the inspector’s responsibility to verify that HMA placement and compaction are conducted to meet specifications and HMA industry standards of practice.

Sampling and Testing Plan

The quality-control plan must contain a quality-control sampling and testing plan that details the sampling and testing to be performed by quality-control personnel. The sampling and testing plan should include each quality characteristic that requires quality control as specified in the contract. The plan should be the basis of information used by the contractor to maintain control of HMA production and placement.

The quality-control plan must also contain a detailed testing program that outlines the quality characteristic to be tested, test method to be used, frequency, and sampling location. The Quality Control Sampling and Testing Plan must meet the minimum quality-control requirements of the specifications. Appendix H shows a sample plan. Samplers and testers who perform quality-control sampling and testing must be qualified in accordance with

Caltrans' independent assurance program.

For HMA compaction, the contractor uses nuclear or non nuclear density gauges to monitor in-place density of each subplot during the compaction process. After the compaction is complete, the contractor takes one core per 250 tons, three per subplot. The contractor's payment and acceptance is based on quality factor determined from the core densities. The density gauge should have a good correlation to the density cores. The density gauge operator does not have to be qualified by Caltrans independent assurance.

If the contractor chooses to use nuclear devices, testers who operate nuclear gauges must be trained and certified in nuclear gauge operation and transportation safety. Testers must be provided with nuclear safety badges, and the contractor must maintain a record of the results of the badge analyses as required. Testing certificates must be from qualified instructors as defined by the California Department of Health.

Caltrans' independent assurance program must qualify samplers and testers who perform quality control, except quality control for compaction using density gauges. The contractor is responsible for samplers and testers maintaining current Qualified Certificate of Proficiency. Those who have not kept their qualifications current or who have been disqualified cannot perform sampling and testing for statistical pay factor process contracts. Tests results after the date of lapse of qualification or disqualification are considered invalid for the purpose of quality-control testing, and associated test results cannot be used for acceptance or payment adjustments.

Random Sampling Plan

The quality-control plan should include a random sampling plan for each quality characteristic that requires quality-control testing as specified in the contract. The sampling plan must address partial subplot, end-of-day tonnage, and the method used to determine random sampling. The sampling plan must also contain a copy of the table of random numbers and procedures for quality-control personnel to determine sampling times and locations. Appendix I shows a random sampling plan.

Laboratories and Equipment

A quality-control testing laboratory includes the following laboratory types that participate in quality control for a contract:

- Main quality-control laboratory
- Field laboratory
- Remote laboratory
- Mobile laboratory

The contractor must check that each quality-control testing laboratory performing AASHTO tests has a current AASHTO-resource accreditation, and each quality-control lab performing California Tests is accredited in accordance with the Caltrans *Independent Assurance Manual*.

The manual is available from your district independent assurance representative:

IA.Service.Request@dot.ca.gov

For each quality-control laboratory, the quality-control plan must include:

- Laboratory name, address, phone, fax, and e-mail.
- Laboratory quality-control manager's name and—if different from above—address, phone, fax, and email.
- Tests to be performed.
- Form TL-0113, "Caltrans Accreditation Laboratory Inspection Report," (Appendix E) for labs performing California Tests. Laboratory accreditations can be verified through the Statewide Independent Assurance Database:

<https://sia.dot.ca.gov/>

- AASHTO resource certificates of accreditation are available on the web at:

<http://www.aashtoresource.org/aap>

Any quality-control laboratory that performs nuclear gauge operation and transportation must be licensed by the California Department of Health, which requires that nuclear gauge operators are certified for safety operation and transportation. Testing laboratories using nuclear gauges on Caltrans projects must be licensed.

The resident engineer or a designee may visit the quality-control laboratories to review the following:

- Facility safety manual
- Safety equipment
- Laboratory procedures manual
- Laboratory quality-control manual
- Copies of current applicable test procedures
- Proper test equipment
- Equipment calibration and service documentation
- Calibration and service decals on all testing equipment
- Availability of contract plans and specifications
- Availability of applicable *Standard Specifications*
- Availability of contract-specific quality control plan

Corrective-Action Plans

The contractor is responsible for understanding what is necessary to keep the process in control, quickly determine when the process has gone out of control, correct the situation,

and bring the process back into control.

Corrective-action plans are not intended to cover all possible problems and their solutions. They are a beginning point to document that the contractor has considered potential breach of action limits and established procedures to correct them.

The contractor must determine and establish action limits for each quality characteristic, based on process-control experience and the variability of test results expected between quality control and acceptance testing. When specified minimum quality characteristics or placement standards are used as action limits, the contractor's risk for out-of-specification material is increased.

The quality-control plan must include a list of anticipated corrective actions needed in the event that production or construction processes do not meet the specified minimum quality characteristics or minimum placement standards. Depending on the severity of the problem, corrective actions may range from minor process adjustments to temporary termination of HMA production.

The quality-control corrective action plan may be presented in table form as shown in Appendix J. At a minimum, the plan should contain actions required to address the following potential situations:

Hot Mix Asphalt Production

- Asphalt content
- Aggregate gradation
- Aggregate moisture
- Mix moisture
- Asphalt binder temperature
- Aggregate temperature
- Mixture volumetrics
- Mix temperature
- Sand equivalent
- Mix segregation
- Uncoated aggregate
- Mixing time
- Mix storage time
- RAP stockpile augmentation

Hot Mix Asphalt Placement

- Subgrade preparation
- Tack coat
- Ambient temperature
- Mix temperature
- Joint construction
- Thickness
- Placement yield
- Cross slope
- Joint offset
- Mix segregation
- Compaction testing
- Smoothness

If problems arise during HMA production and placement, the contractor must notify the resident engineer, and identify the problems, the means undertaken to pinpoint the cause, and anticipated corrections. The specifications contain requirements for notification and production termination. Corrective actions must be documented in the records of inspection.

Documents

The quality-control plan identifies the forms to use to document the contractor’s quality-control process, which are detailed enough to provide the contract-required information. The following documentation must be provided to the resident engineer:

Hot Mix Asphalt Construction Daily Record of Inspection

Two daily inspection reports, Form CEM-3501, “Hot Mix Asphalt (HMA) Production Report,” and Form CEM-3502, “Hot Mix Asphalt Placement Report,” must be submitted to the resident engineer by noon the day following the inspection.

Hot Mix Asphalt Daily Summary of Quality Control Testing

Form CEM-3803, “Hot Mix Asphalt Daily Summary of Quality Control Testing,” required for each day’s production and placement, summarizes the results of each quality characteristic tested.

Individual test records showing all data collected and calculations performed must be attached to Form CEM-3803, signed by the tester, and initialed by the quality-control manager. The test result data shown on this form for each subplot should be the quality-control data entered into the SPF Pay program and sent to the resident engineer. For more information on the SPF Pay program, see “HMA SPF Pay Program” in this manual.

Test results outside action limits or specification limits must be circled on Form CEM-3803. Initial submittal of the form is required within the maximum time for reporting 24-hour results, usually by noon the next business day. Within 48 hours of sampling, submit a final Form CEM-3803 with all test results specified to be reported within 48 hours of sampling.

Hot Mix Asphalt Inspection and Testing Summary

Form CEM-3804, “Hot Mix Asphalt Inspection and Testing Summary,” is required for each day’s production and placement. This form includes a checklist showing the inspections and testing conducted for the day.

For quality-control test results on the form that are outside the action limit or specification limit, the contractor must take corrective action to bring the process back to control and document the action on Form CEM-3804. If the contractor must stop production and placement because of quality factors or two consecutive quality control tests or three quality control tests in a single day out of action or specification limit, the contractor documents all steps taken on Form CEM-3804 before resuming production and placement.

Form CEM-3804 contains the following statement:

It is hereby certified that the information contained in this record is accurate and that information, tests, or calculations documented herein comply with contract specifications and standards set forth in the testing procedures. Exceptions to this certification are documented as part of this record.

The quality-control manager signs Form CEM-3804 for certification and submits it to the resident engineer by noon the next business day following HMA production and placement. For test results specified to be reported within 48 hours, the quality-control manager submits to the resident engineer the final daily Form CEM-3804, showing all test results within 48 hours of sampling.

For at least three years after final acceptance, the contractor must retain for inspection the records generated as part of quality control, including the quality-control plan and its supplements, inspection reports, daily summary of testing, test results, and HMA inspection and testing summary.

Quality Control Plan Checklist

To assure that quality-control plans are complete and that resident engineers’ reviews of HMA quality-control plans are consistent statewide, a “Quality Control Plan Review Checklist for Hot Mix Asphalt” is available. Contractors should use the “Quality Control Plan Review Checklist for Hot Mix Asphalt” (Appendix K) as a guide when reviewing quality control plans for

completeness prior to submittal. The checklist has a column the contractor can check for submittal completeness and columns for the resident engineer to use during review of the quality-control plan to indicate whether each section of quality-control plan is complete or incomplete.

QUALITY CONTROL IMPLEMENTATION

Quality-Control Plan Submittal and Acceptance

The contractor should submit the quality-control plan to the resident engineer with the JMF submittal. The resident engineer has five business days to review the quality-control plan and either return the plan with comments or accept the submitted quality-control plan.

A supplemental quality-control plan needs to be submitted to the resident engineer when any of the following occur:

1. Quality-control staff is added to a project.
2. A testing laboratory is changed, or a laboratory is added to a project.
3. The Qualified Certificate of Proficiency (Form TL-0111) expires and a revised Form TL-0111 is submitted.
4. Testing laboratory receives an updated accreditation.

Independent Assurance

It is important for the contractor to use qualified testers and accredited laboratories so that the quality-control test results can be used for HMA acceptance tests once verified by the engineer and then be used to determine the applicable payment adjustment. The contractor needs to perform periodic reviews of tester qualifications and laboratory accreditation that were submitted as part of the quality-control plan. Tester certifications and laboratory accreditations can be verified through the Statewide Independent Assurance Database

<https://sia.dot.ca.gov/>

The Federal Highway Administration requires that each state transportation agency have a quality assurance program for federal-aid highway construction projects. Each state highway agency must develop sampling and testing programs to assure that materials and work quality incorporated in federal-aid highway construction projects conform to requirements of approved plans and specifications.

Caltrans independent assurance representatives qualify all testers, verify that equipment used for required testing is properly calibrated and in good working condition, and verify that testers are trained in the testing procedures and can demonstrate a level of proficiency. During construction, it may be necessary for an independent assurance representative to verify the reliability of any quality-control tester by witnessing sampling and testing and by splitting samples and comparing results. A Caltrans independent assurance representative has the authority to decertify testers who deviate from accepted sampling and testing procedures.

It is the responsibility of the contractor to keep the quality control tester's Qualified Certificate of Proficiency Form TL-0111 current. Testers whose qualification has lapsed or been revoked may not provide materials test results for acceptance consideration.

Each quality-control testing laboratory must be accredited in accordance with the Caltrans *Independent Assurance Manual*, Procedures for Accreditation of Laboratories and Qualification

of Testers For a copy, send an email to:

IA.Service.Request@dot.ca.gov

Quality Control During Hot Mix Asphalt Production and Placement

The contractor must establish, maintain, and change, if necessary, a quality-control program to provide assurance that the HMA complies with the specifications. The quality-control program must be implemented early when lime treatment of HMA aggregates for moisture sensitivity is required, so aggregate quality characteristics of untreated aggregates can be sampled and tested.

For most projects, the HMA quality-control program is implemented on the first day of HMA production. The contractor must provide daily reports of inspection for both production and placement. For each 750 tons of production and placement, the contractor must provide documented inspection, sampling, and testing in compliance with the specifications.

For any quality-control test result outside action limit or specification limit, the contractor must take corrective action to bring the process back to control and document the action on Form CEM-3804, "Hot Mix Asphalt Inspection and Testing Summary." If the contractor must stop production and placement because quality-control tests are out of action or specification limit, the contractor documents all steps taken on Form CEM-3804 before resuming production and placement.

When a quality-control test result is outside the action limit or specification limit, the contractor must stop asphalt production and placement, notify the resident engineer in writing, take corrective action to bring process back to control, document actions on Form CEM- 3804, and demonstrate compliance with specifications before resuming production and placement on the State Highway System if:

- A lot's composite quality factor is below 0.90
- The individual quality factor for numbers 2, 3, 4, or 5 is below 0.90
- The individual quality factor index number 1 is below 0.75
- A non-pay factor quality characteristic has two consecutive quality-control tests not in compliance with the specifications.
- Any three quality characteristics are out of specification in a single day.

Before resuming production and placement, the contractor documents all steps taken on Form CEM-3804.

As part of quality-control implementation, the contractor must enter quality-control test results into the Caltrans-provided SPF Pay program. The SPF Pay program has a quality-control subprogram that calculates a set of quality factors for the following quality requirements:

- Aggregate gradation on the Number 8 sieve
- Aggregate gradation on the Number 200 sieve

- Asphalt binder content
- Percentage of maximum theoretical density
- Air voids

Documentation is an important part a quality-control program and can show clearly that a contractor is in control of HMA production and placement processes. Documentation includes the quality-control plan and its supplements. During the progress of the work, the contractor must submit plan supplements in writing to the resident engineer for changes to quality-control procedures, personnel, tester qualification status, or laboratory accreditation.

For each day of HMA production and placement, the following documents must be submitted to the resident engineer:

- Form CEM-3501, “Hot Mix Asphalt Production Report”
- Form CEM-3502, “Hot Mix Asphalt Placement Report”
- Form CEM-3803, “Daily Summary of Quality Control Testing” (with attached forms showing data calculations and test values)
- Form CEM-3804, “Hot Mix Asphalt Inspection and Testing Summary”

The contractor must maintain hard copies of all quality-control documents for three years after final contract acceptance.

Production Startup Evaluation

The two main purposes of the production startup evaluation are to assure that the HMA conforms to the verified job mix formula for the project and to verify that the contractor’s quality-control test results agree with the resident engineer’s test results, and vice versa. Test-result differences must be resolved early to prevent potential disputes.

On the first day of HMA production, the production startup evaluation must occur within the first 750 tons of HMA produced. The contractor must take samples of aggregate, reclaimed asphalt pavement, asphalt binder, and hot mix asphalt from the same production run and in the resident engineer’s presence. The samples are split into four parts. Three parts are submitted to the resident engineer, and one is tested by the contractor.

A new production start-up is required when production stops for more than 60 days. If production stops for more than 30 and less than 60 days, a “reduced” production start-up evaluation is required. A “reduced” production start-up evaluation is a production start-up evaluation without the Hamburg wheel track (AASHTO T 324, Modified), “Hamburg Wheel-Track Testing of Compacted Hot Mix Asphalt (HMA),” and the moisture susceptibility (AASHTO T 283), “Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage.”

Hamburg wheel track and moisture susceptibility during production start-up are not required if the production start-up is within 45 days of the date the HMA verification Form CEM-3513,

“Caltrans Hot Mix Asphalt Verification,” is signed.

For percentage of maximum theoretical density, the contractor must take one 4-inch diameter core for every 250 tons of production startup evaluation HMA at locations the resident engineer designates. The resident engineer must perform and report the bulk specific gravity using AASHTO T 275, Method A, “Bulk Specific Gravity of Compacted HMA Using Paraffin-Coated Specimen” and the percent of maximum theoretical density. The contractor may test for in-place density at the core locations and calibrate nuclear gauges based on production startup evaluation test results.

The production startup evaluation test results are recorded on Form CEM 3703, “Caltrans Production Start-up Evaluation.” All test results must be reported in writing within 3 business days of sampling.

Both contractor and resident engineer test results should meet specification requirements for all quality characteristics except those with quality factors. Results should be within the target value tolerance for each quality characteristic with a quality factor, except density. The resident engineer’s test results for density should be within specification acceptance limits.

Production startup evaluation test results are based on split-sampled material, eliminating the variability in sampling from the test results. Since the resident engineer’s test results are used to verify the contractor’s quality control test results, the contractor should pay special attention to the differences between the contractor’s and resident engineer’s test results for split sample results. If the contractor finds any testing differences unacceptable, the contractor may want to resolve these testing differences with the resident engineer before proceeding with HMA production and placement.

Dispute Resolution

Dispute resolution is an integral part of the hot mix asphalt SPF process. The aim of the dispute resolution process is to resolve contractor and resident engineer disagreements regarding test result comparisons.

Disputes related to quality characteristic tests that are evaluated with a quality factor (pay factor) can only be resolved after the verification process is complete. This is because the specifications do not allow the engineer to share test results until the testing on the lot being verified is complete. The contractor can only dispute the verification process, and not individual test results.

For quality characteristics tests that are not evaluated with a quality factor (pay factor), the contractor can dispute individual test results.

When the resident engineer or contractor disputes a test result, the dispute should be resolved at the lowest level possible. The resident engineer and contractor should review test results and when possible, witness each party’s performance with a disputed test result to determine the source of any testing error including sampling, testing, or testing equipment. If they are unable to determine the source for a testing error, an independent third party (ITP) laboratory

must act as witness and referee to resolve the dispute.

When an ITP laboratory is used to resolve testing disputes for quality characteristics without quality factors, the laboratory must test the dispute resolution sample for the test result contested. The laboratory must determine whether the test result for the dispute resolution sample indicates that the resident engineer's test result is beyond the expected test results of a reasonable laboratory conducting the same test on the same sample. Only after the ITP testing has shown that the resident engineer's test result is unreasonable, is that test result replaced by the ITP test result for acceptance of the quality characteristic.

When an ITP laboratory is used to resolve testing disputes involving quality characteristics compliance determined by quality factors, the laboratory must examine all the test results for the lot. If the verification result of a particular lot is disputed, the ITP selects and tests 5 random engineer samples from the remaining sublots. The engineer and contractor must agree to the representative samples to be tested by the ITP. The ITP tests only the disputed quality characteristics that failed verification. The ITP conducts the verification of the contractors' unverified test using the 5 ITP tests. If the verification concurs, the contractor's quality control test results are used for acceptance. If the verification does not concur with the contractor's results, the 5 ITP test results are used for acceptance.

HMA SPF Pay Program

The contractor must submit the quality-control test results by entering data into the Caltrans-provided SPF Pay program. The program has a subprogram that calculates individual and composite quality factors based on quality-control test results input by the contractor. A set of quality factors consists of the composite (QFc) and five individual quality factors (QFQC_i where $i = 1$ to 5). The quality-control subprogram starts the first set of quality factors computation at the third subplot using quality-control test data from all first three sublots.

The pay program continues calculating the set of quality factors from the fourth to twentieth sublots using quality-control test data from all previous sublots. The contractor must stop production, notify the resident engineer in writing, take corrective action, and demonstrate compliance with specifications before resuming production and placement on the State Highway System if:

- The lot's composite quality factor is less than 0.90
- The individual quality factor for index numbers 2, 3, 4, or 5 is below 0.90
- The individual quality factor for index number 1 is below 0.75

The contractor documents all steps taken before resuming production and placement on Form CEM-3804, "Hot Mix Asphalt Inspection and Testing Summary."

The composite quality factor used to determine the contractor's final payment adjustment on the lot is based on the contractors' verified quality-control test data for binder content, air voids, the Number 8 and Number 200 sieves, combined with the engineer's percent of maximum theoretical density determined from cores. During production, the contractor's

percent theoretical maximum density is used to calculate a quality factor. If this quality factor is less than 0.90, the contractor must stop production, notify the resident engineer in writing, take corrective action, and demonstrate compliance with the specifications before resuming production.

The contractor must export the quality-control data entered into the SPF Pay program and submit an exported file to the resident engineer daily. Contractors may use their own software to monitor the quality factors developed each in each subplot but must demonstrate that when imported to the HMA SPF program, the software actively monitors individual quality factor values to alert the quality-control manager if values fall below 0.90, or 0.75 for the Number 8 sieve. Previously approved versions of vendor software will be listed on the Caltrans Division of Construction Hot Mix Asphalt page at:

<https://dot.ca.gov/programs/construction/hot-mix-asphalt-construction>

The resident engineer enters verification test data into the HMA SPF Pay program that contains the quality-control data provided daily by the quality-control manager. The engineer uses the subprogram for verification and to determine acceptance and any final payment adjustments for each lot.

The HMA SPF Pay program is online:

<https://dot.ca.gov/programs/construction/hot-mix-asphalt-construction>

REFERENCES AND RESOURCES

The following list provides contractor personnel with additional sources of information:

California Test Methods, Materials and Engineering Testing Services (METS), California Department of Transportation (Caltrans)

<https://dot.ca.gov/programs/engineering-services/california-test-methods>

Certification Program for Suppliers of Asphalt, METS, Caltrans

<https://dot.ca.gov/programs/engineering-services/asphalt-supplier-certification-program>

Division of Construction Forms, Caltrans

<https://dot.ca.gov/programs/construction/forms>

Independent Assurance Manual, Caltrans

Email: IA.Service.Request@dot.ca.gov

Materials Plant Quality Program manual, Division of Construction, Caltrans

<https://dot.ca.gov/programs/construction/material-plant-quality-program>

Construction of Hot-Mix Asphalt Pavements, published by the Asphalt Institute

<https://mx.asphaltinstitute.org/Shop/Product-Details?productid=F101BB34-2E1E-E811-80F4-000D3A01109B>

Standard Specifications, published by the Caltrans

<https://dot.ca.gov/programs/design/ccs-standard-plans-and-standard-specifications>

Tack Coat Guidelines, Division of Construction, Caltrans

<https://dot.ca.gov/programs/construction/hot-mix-asphalt-construction>

Minimum Tack Coat Spray Rates, Division of Construction, Caltrans

<https://dot.ca.gov/programs/construction/hot-mix-asphalt-construction>

FEEDBACK

Contractors should contact the resident engineer for the project-specific questions and comments about the hot mix asphalt SPF QC program. Caltrans invites feedback regarding this manual and welcomes users' suggestions for making the SPF QC program more effective. Please contact:

Headquarters SPF QC Program Coordinator

California Department of Transportation, Division of Engineering Services

Materials Engineering and Testing Services, Office of Flexible Pavement, MS 5

5900 Folsom Boulevard

Sacramento, CA 95819-4612

Telephone: (916) 227-7306

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Appendix A Sample Contractor Quality-Control Plan Submittal Letter

CONTRACT 00-111114
ABC-180-R97.1/R103.1

June 22, 2018

The purpose of this quality-control plan is to direct the activities of Big Orange Construction Company to assure that the construction materials and construction meet or exceed the quality requirements of the contract specifications.

The quality-control program includes personnel from the following organizations. Paraway Refinery of Sacramento will provide the asphalt, Quality Aggregates of Grass Valley will provide the coarse and fine aggregate, and Best Mixes of Elk Grove will provide hot mix asphalt design. AC Producer Corporation of Auburn will provide and ship the hot mix asphalt, and the Sacramento office of Big Orange Construction will place the hot mix asphalt. Materials Testers, Inc. of Elk Grove will provide street and plant inspection and quality-control testing.

Quality-control personnel in all organizations involved in this contract are independent from the pressures of production and have the organizational freedom to identify quality problems and initiate action that will affect solutions, including action that precludes recurrence. All quality-control personnel have been provided with a clearly defined level of authority.

The quality-control manager and the alternate quality-control manager are employees of Materials Testers, Inc. of Elk Grove. The quality-control manager is given full responsibility and authority to implement and maintain the quality-control plan.

Big Orange Construction management has approved and required implementation of this plan by producers and suppliers and directs that compliance to this plan is mandatory.

BIG ORANGE CONSTRUCTION COMPANY

George B. Orange

President

Appendix B Sample QCP Certification

Contractor Quality Control Plan
for Contract 00-111114
ABC-180-R97.1/R103.1

June 22, 2018

Prepared for

Big Orange Construction Company
P.O. Box 87
Sacramento, California 9958x

by

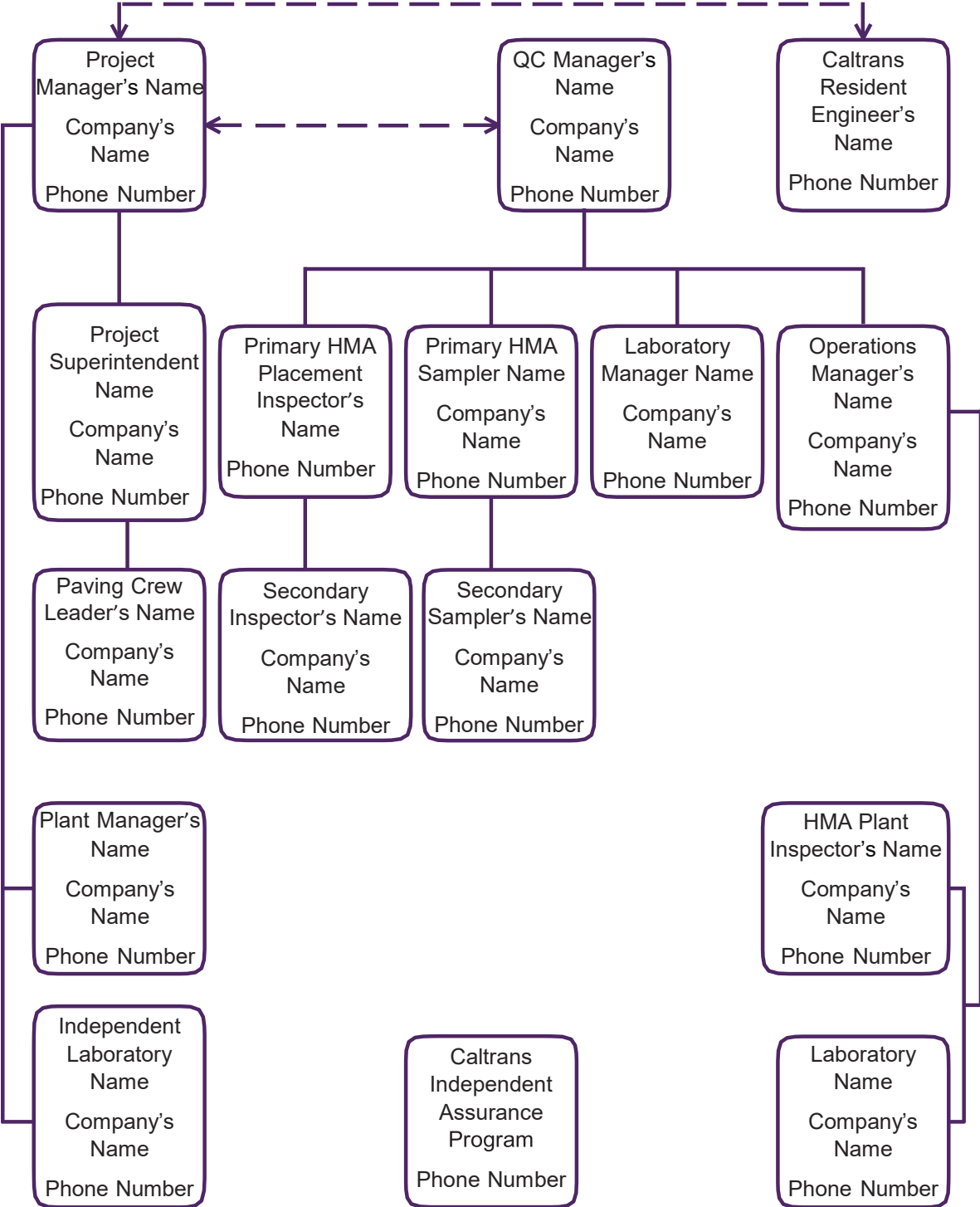
Material Testers LLC
215 West Main Street
Elk Grove, California 96000

It is hereby certified that the information contained in this quality-control plan for contract 00-111114 meets the requirements of contract specifications and the *Quality Control Manual for Hot Mix Asphalt Using Statistical Pay Factors* dated February 2020. This quality-control plan identifies qualified testing personnel and laboratories accredited in accordance with the *Independent Assurance Manual*.

Signature and date

Ira M. Quewcey, Quality Control Manager

Appendix C Sample Organizational Chart



Appendix D Sample Quality Control Manager's Qualifications

IRA M. QUEWCEY
24 Curved Bridge Road
Elverta, CA 95673
(916) 555-1234

Professional Registration: Civil Engineer, California # C XXXXX

Education: B.S.C.E. Sacramento State University, 2005

American River Community College, 1978

Background: More than 40 years' experience with construction materials in various capacities. Hot mix asphalt experience includes field sampling, testing, mix designs, and field inspection in both public and private sectors.

Employment History:

2011-Present—Quality Control Manager
Materials Testers, Inc.

- Responsible for the operation of three material laboratories.
- Perform inspection of laboratory equipment to ensure calibration and operating conditions.
- Schedule technicians and inspectors for both field and laboratory assignments.
- Provide professional development and training for staff.
- Review test results and inspection reports for accuracy or deficiencies.

1995-2011—Laboratory Technician
Materials Testers, Inc.

- Performed aggregate, concrete, and hot mix asphalt sampling and testing.
- Performed portland cement concrete and asphalt concrete mix designs.

Appendix D Sample Quality Control Manager’s Qualifications (continued)

1970-1985—Plant Inspector
Napa County


- Performed portland cement concrete and asphalt concrete plant inspection.
- Sampled and tested aggregate for gradation and sand equivalent.
- Performed asphalt extraction tests.

1978-1980—Survey Technician
State of California

- Rear chain worker on a Division of Highways survey party.

Testing Qualifications:	CTM-125 TL-0111	AASHTO T 176
(Attached)	AASHTO T 27	AASHTO T 308 (Method A)
	AASHTO T 176	AASHTO T 283
	AASHTO T 324 (Mod)	AASHTO T 308 (Modified)
	AASHTO T 329	AASHTO T 335

Appendix E TL-0111 Certification for Test Performance



SIAD TL-0111: CT CERTIFICATION

CALIFORNIA DEPARTMENT OF TRANSPORTATION

Presents this CERTIFICATE to

[Redacted Name]

who is certified to perform the following tests:


Test Method	Expiration Date	IA Responsible	Associated Laboratory
CT 125 AGG	2019-10-04	[Redacted]	Lab 1
CT 125 GEN	2019-10-04	[Redacted]	Lab 1
CT 125 HMA	2019-10-04	[Redacted]	Lab 1

Lab 1: District 9 Construction, 500 S. Main St., Bishop

Certified Independent Assurance (IA)
Date issued: 03/12/2019

Note: This certificate is valid as long as the Tester complies with applicable requirements in Caltrans' Independent Assurance Program Manual.

Appendix E TL-0113 Certification for Test Performance (continued)



SIAD TL-0113: CALTRANS ACCREDITATION LABORATORY INSPECTION REPORT

STATE OF CALIFORNIA

DEPARTMENT OF

TRANSPORTATION

CALTRANS ACCREDITATION LABORATORY INSPECTION REPORT

Expiration Date: 2019-06-12

Inspected By: _____

IA No.: 99

Phone: _____

RSP #: 491

File: Material Category 500

Laboratory: _____

Address: _____

Lab QC Mgr.: _____

E-mail: _____

Telephone: _____

Fax #: _____

A certified Independent Assurance (IA) visited this laboratory on (Date) _____

Only the equipment to be used on Caltrans Construction projects and/or local construction projects on the National Highway System was checked for qualification. At the time of Caltrans Accreditation, this laboratory had all necessary equipment to perform the test methods indicated below.

Testing personnel shall be Caltrans Qualified and possess a current Caltrans Certification Form TL-0111 or AASHTO Proficiency Form TL-0115 prior to performing any sampling or testing.

AASHTO T11	AASHTO T27	AASHTO R47	AASHTO R76	AASHTO T166
AASHTO T176	AASHTO T209	AASHTO T248	AASHTO T255	AASHTO T269
AASHTO T275	AASHTO T308	AASHTO T329	AASHTO T335	CT 105
CT 125 ADMIX	CT 125 AGG	CT 125 BIT	CT 125 GEN	CT 125 HMA
CT 201	CT 202	CT 205	CT 216	CT 217
CT 226	CT 227	CT 229	CT 231	CT 504
CT 518	CT 539	CT 540	CT 556	CT 557

A visual check was performed and documents provided as necessary for the following items:

_____ Facility Safety Manual _____ Laboratory Procedures Manual _____ Laboratory Quality Control Manual _____ Proper test equipment	_____ Copies of current applicable test procedures _____ Calibration and service documentation _____ Calibration stickers affixed to test equipment (dated within the 12 months)
--	--

On _____, this laboratory was Caltrans Qualified by:

_____ (Printed name of IA person)	_____ (Signature of IA person)
--------------------------------------	-----------------------------------

Please verify lab accreditation by visiting SIAD website: <https://sia.dot.ca.gov/>
Page 1/1

Appendix F Sample Hot Mix Asphalt Production Inspection Plan

Contract 00-111114 Hot Mix Asphalt Placement Inspection Plan

Quality Characteristic	Type of Inspection	Frequency	Location	Responsibility	Tolerance
HMA Designation	Visual	Daily	Plant Control Room	Plant Inspector	Per Approved JMF
Aggregate Storage	Visual	Daily	Bins and Cold Feeds	Plant Inspector	Graded and Separated
Aggregate Source	Visual	Daily	Plant	Plant Inspector	Per Approved JMF
Baghouse Fines	Visual	Daily	Plant	Plant Inspector	Metering
Scales and Meters	Visual and Certification	Daily	Plant	Plant Inspector	Sealed per MPQP
Controller Interlocks	Visual	Daily	Plant	Plant Inspector	Per MPQP
Temperature Devices	Visual	Daily	Plant	Plant Inspector	Verify Operational
Asphalt Binder Temperature	Temperature Equipment	Continuous	Plant	Plant Inspector	Per Specifications
Asphalt Binder Grade	Certificate	Daily	Plant	Plant Inspector	Per Approved JMF
Belts and Feeds	Visual	Daily	Plant	Plant Inspector	Industry Standards
Composite Aggregate Grading	Test Report	Hourly	Plant	Plant Inspector	Per Approved JMF
Aggregate Temperature	Temperature Equipment	3 per day minimum	Plant	Plant Inspector	Per Specifications
HMA Temperature	Temperature Equipment	3 per day minimum	Plant	Plant Inspector	Per Specifications
Truck Beds	Visual	Daily	Plant	Plant Inspector	No Petroleum Based
Storage Silos	Visual	Daily	Plant	Plant Inspector	Per MPQP

Appendix F Sample Hot Mix Asphalt Production Inspection Plan (continued)

Contract 00-111114 Lime Treatment Inspection Plan

Quality Characteristic	Type of Inspection	Frequency	Location	Responsibility	Tolerance
Lime Treatment Designation	Visual	Daily	Plant Control Room	Plant Inspector	Per Approved JMF
Aggregate Storage	Visual	Daily	Stockpiles	Plant Inspector	Graded and Separated
Aggregate Source	Visual	Daily	Plant	Plant Inspector	Per Approved JMF
Scales and Meters	Visual and Certification	Daily	Plant	Plant Inspector	Sealed per MPQP
Controller Interlocks	Visual	Daily	Plant	Plant Inspector	Per MPQP
Treatment Data Collection	Visual	Daily	Plant	Plant Inspector	Per Specifications

Contract 00-111114 Liquid Antistrip Inspection Plan

Quality Characteristic	Type of Inspection	Frequency	Location	Responsibility	Tolerance
Liquid Antistrip Treatment	Visual	Daily	Plant Control Room	Plant Inspector	Per Approved JMF
Antistrip Source	Visual and Certificate of Compliance	Daily	Plant	Plant Inspector	Per Approved JMF
Scales and Meters	Visual and Certification	Daily	Plant	Plant Inspector	Sealed per MPQP
Controller Interlocks	Visual	Daily	Plant	Plant Inspector	Per MPQP
Treatment Data Collection	Visual	Daily	Plant	Plant Inspector	Per Specifications

Appendix F (continued) Sample Hot Mix Asphalt Production Inspection Plan

Contract 00-111114 Liquid Asphalt Pavement Inspection Plan

Quality Characteristic	Type of Inspection	Frequency	Location	Responsibility	Tolerance
Reclaimed Asphalt Pavement	Visual	Daily	Plant Control Room	Plant Inspector	Per Approved JMF
RAP Source	Visual	Daily	Plant	Plant Inspector	Per MPQP
Scales and Meters	Visual and Certification	Daily	Plant	Plant Inspector	Sealed per MPQP
Controller Interlocks	Visual	Daily	Plant	Plant Inspector	Per MPQP
RAP Moisture Content	Test Report	Twice a Day	Plant	Plant Inspector	Per Specifications
RAP Grading	Test Report	Daily	Plant	Plant Inspector	Per Approved JMF

Appendix G Sample Hot Mix Asphalt Placement Inspection Plan

Contract 00-111114 Hot Mix Asphalt Placement Inspection Plan

Inspection Item	Type of Inspection	Frequency	Location	Responsibility	Attribute or Tolerance
Subgrade Preparation	Visual	Daily	Job Site	Placement Inspector	Smooth and Clean
Tack Coat	Visual and Weigh-master Certificates	Per Load	Subgrade Surface	Placement Inspector	Residual Rate and Cover
Paving Fabric	Visual	Daily	Job Site	Placement Inspector	Per Specifications
Windrow Temperature	Temperature Equipment	Hourly	Job Site	Placement Inspector	Per Specifications
Windrow Segregation	Visual	Hourly	Job Site	Placement Inspector	Industry Standard
Pick-Up Machine	Visual	Daily	Job Site	Placement Inspector	Manufacturer Standards
Asphalt Paver and Hopper	Visual and Measure	Daily	Job Site	Placement Inspector	Manufacturer Standards
Paving Process	Visual	Continuous	Job Site	Placement Inspector	Industry Standards
Compaction Equipment	Visual and Measure	Daily	Job Site	Placement Inspector	Manufacturer Standards
Compaction Process	Visual	Continuous	Job Site	Placement Inspector	Per Contractor Established Rolling Pattern
HMA Mat Temperature at Breakdown	Measure Temperature	Hourly	Behind Paver	Placement Inspector	Industry Standards or Specifications for Method
HMA Mat Temperature at Finish	Measure Temperature	Hourly	Behind Finish Roller	Placement Inspector	Industry Standards or Specifications for Method
HMA Mat Temperature Before Open to Traffic	Measure Temperature	Prior to Opening	Finished Mat	Placement Inspector	Per Specifications

Appendix G Sample Hot Mix Asphalt Placement Inspection Plan (continued)

Contract 00-111114 Hot Mix Asphalt Placement Inspection Plan (continued)

Inspection Item	Type of Inspection	Frequency	Location	Responsibility	Attribute or Tolerance
Lift Thickness	Measure	Hourly	Behind Paver	Placement Inspector	Per Specifications
Longitudinal Transverse Joints	Visual	Continuous	Pave-ment Joints	Placement Inspector	Industry Standards
Pavement Smoothness	Inertial profiler or 12-foot Straight edge	Hourly	Finished Surface	Placement Inspector	Per Specifications
Pavement Transitions	Visual	Daily	At Transition	Placement Inspector	Per Specifications

Appendix H Sample Quality Control Sampling and Testing Plan

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	Location of Sampling	Maximum Reporting Time Allowance
Aggregate Gradation	AASHTO T 27	1 per 750 tons	Plant	24 hours
Reclaimed Asphalt Pavement Gradation	CT 384	Daily	RAP System	24 hours
Reclaimed Asphalt Pavement Moisture Content	AASHTO T 255	Daily	RAP System	24 hours
Combined Reclaimed Asphalt Pavement Asphalt Binder Content	AASHTO T 308 (Method A)	1 per 1,000 tons with a minimum of 6 samples per fractionated stockpile. If RAP stockpile is augmented, 1 per 500 tons of augmented RAP	RAP stockpile	24 hours
Reclaimed Asphalt Pavement Maximum Specific Gravity	AASHTO T 209	1 per 1,000 tons with a minimum of 6 samples per fractionated stockpile. If RAP stockpile is augmented, 1 per 500 tons of augmented RAP	RAP stockpile	24 hours
Asphalt Binder Content	AASHTO T 308 Method A	1 per 750 tons and any remaining part	Loose Mix Behind Paver	24 hours
Density of Core	AASHTO T 275, Method A	1 per 250 tons, use average of 3 per subplot	Compacted mat	24 hours

**Appendix H Sample Quality Control Sampling and Testing Plan
(continued)**

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	Location of Sampling	Maximum Reporting Time Allowance
Nuclear or non nuclear gauge density calibrated to cores	Not applicable	As required to monitor the compaction process.	Compacted mat	Instantaneous
Theoretical Maximum Density	AASHTO T 209 Method A	3 on the first day, 1 per paving day thereafter. Use the running average of 3 test results	Loose Mix Behind Paver	24 hours
Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants	AASHTO T 255	1 per 750 tons and any remaining part	Stockpiles or Cold Feed Belts	24 hours
Sand Equivalent (minimum)	AASHTO T 176	1 per 750 tons	Plant	24 hours
HMA Moisture Content (maximum)	AASHTO T 329	1 per 2,500 tons but not less than 1 per paving day	Loose Mix Behind Paver	24 hours
Hamburg Wheel Track	AASHTO T 324 (Modified)	At JMF Verification and Production Startup only,	Plant	Within 15 business days of sampling

**Appendix H Sample Quality Control Sampling and Testing Plan
(continued)**

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	Location of Sampling	Maximum Reporting Time Allowance
Moisture Susceptibility	AASHTO T 283	At JMF Verification and Production Startup only, not required during production	Plant	Within 15 business days of sampling
Air Voids Content percent	AASHTO T 269	1 per 1,500 and any remaining part	Loose Mix Behind Paver	48 hours
Percent of crushed particles coarse aggregate (percent minimum) One fractured face Two fractured faces Fine aggregate (percent minimum) (Passing Number 4 sieve and retained on Number 8 sieve)	AASHTO T 335	1 every 10,000 tons or 2 per project, whichever is greater	Plant	48 hours
Los Angeles Rattler (percent maximum) Loss at 100 revolutions Loss at 500 revolutions	AASHTO T 96	1 every 10,000 tons or 2 per project whichever is greater	Plant	48 hours
Fine aggregate angularity (percent minimum)	AASHTO T-304, Method A	1 every 10,000 tons or 2 per project whichever is greater	Plant	48 hours

**Appendix H Sample Quality Control Sampling and Testing Plan
(continued)**

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	Location of Sampling	Maximum Reporting Time Allowance
Flat and elongated particle (percent maximum at 5:1)	ASTM D 4791	1 every 10,000 tons or 2 per project whichever is greater	Plant	48 hours
Voids in mineral aggregate (percent minimum)	MS-2	1 every 10,000 tons or 2 per project whichever is greater	Loose Mix Behind Paver	48 hours
Dust proportion	MS-2	1 every 10,000 tons or 2 per project whichever is greater	None Calculation	48 hours
Asphalt rubber binder viscosity at 350°F in centipoises	ASTM D7741/D7741 M	1 every four hours of production	Feed Line to HMA Plant	1 per lot defined by the Caltrans MPQP
Crumb Rubber Modifier Scrape Tire Gradation (percent passing Number 8 sieve)	CT 385	1 every 10,000 pounds	CRM Bag	48 hours
Crumb Rubber Modifier High Natural Gradation (percent passing Number 10 sieve)	CT 385	1 every 3,400 pounds	CRM Bag	48 hours

**Appendix H Sample Quality Control Sampling and Testing Plan
(continued)**

Quality Characteristic	Test Method	Minimum Sampling and Testing Frequency	Location of Sampling	Maximum Reporting Time Allowance
Natural rubber content in high natural crumb rubber	ASTM D297	1 every 3,400 pounds	CRM Bag	48 hours
Wire in CRM (percent maximum)	CT 385	1 every 10,000 pounds for scrap tire	CRM Bag	48 hours
Fabric in CRM (percent maximum)	CT 385	1 every 10,000 pounds for scrap tire	CRM Bag	48 hours

Appendix I Sample Quality Control Random Sampling Plan

Daily quality control samples will be obtained at milestones using a random sampling plan. (Refer to ASTM D 3665 for random number tables.) Use the following procedure to determine the sampling milestones before the start of each day's production:

Random Sampling Procedure

1. Using the Random Number Table (attached), randomly select a block of numbers.
2. Multiply the random number by the subplot quantity.
3. Add this value to the subplot factor to determine the first sampling milestone (tons of production at which a sample will be taken).

Example:

Planned Day's Production = 3100 tons Sampling Frequency = 1 sample per 750

Lot Number	Sublot Number	Random Number (a)	Sublot Quantity (b)	Sublot Factor (c)	Milestone (a) x (b) + (c)
1	1	31	750	0	233
1	2	12	750	750	840
1	3	29	750	1500	1718
1	4	86	750	2250	2895

Appendix J Sample Corrective Action Plan—Hot Mix Asphalt Production

Quality Characteristic	Action Limit	Corrective Action
Asphalt Binder Content Type A	JMF ± 0.40	If test results are outside tolerance, an immediate investigation will be conducted to determine the cause. Corrections will be made and material tested immediately to verify that the correction has been effective.
Asphalt Binder Content RHMA-G	JMF ± 0.45	If test results are outside tolerance, an immediate investigation will be conducted to determine the cause. Corrections will be made and material tested immediately to verify that the correction has been effective.
Aggregate Gradation	JMF \pm Specification Tolerance	If test results are outside tolerance, an immediate investigation will be conducted to determine the cause. Corrections will be made to piles, bins, belts, or scales; and material will be tested immediately to verify that the correction has been effective.
Aggregate Moisture	None Adjust	When individual or composite aggregate moisture values differ from those of the plant computer, the plant computer will be adjusted to reflect the most recent aggregate moisture.
Asphalt Binder Temperature	275°F–375°F	If the asphalt binder temperature exceeds the range allowed, the plant operator will immediately take corrective action to raise or lower the temperature as needed. Temperature will be closely monitored to verify that the correction was adequate.
Mix Temperature	325°F	If mix temperature exceeds 325°F, the plant operator will immediately take corrective action to lower the temperature. Temperature will be closely monitored to verify that the correction was adequate. HMA that exceeds 350°F will be disposed of.
Mix Moisture Content	>1%	If the mix moisture exceeds 1 percent, the plant operator will be notified and corrective action taken to reduce the moisture in the mix; for example, aggregate piles may be spread to dry, or aggregate time in the heater may be increased.

Appendix J (continued) Sample Corrective Action Plan—Hot Mix Asphalt Placement

Placement Standard	Action Limit	Corrective Action
Subgrade Preparation	Zero Tolerance	If inspection indicates that the subgrade is not prepared as specified, immediate action will be taken. Subgrade problems will be corrected—dried, cleaned, compacted, graded. HMA will not be placed until the corrections have been made and the QC manager has inspected and approved them.
Tack Coat	± .01 gal/sq yd	If contractor fails to submit documentation for the minimum spray rate required to achieve the minimum residual rate and dilution rate documentation (if any), the paving crew leader will be notified, and placement will cease as soon as safety concerns have been provided for. If inspection indicates that the tack coat material or applications are not in accordance with the specifications, immediate action will be taken; for example, tack coat may be re-applied or changed, or time for “break” may be lengthened. HMA will not be placed until the corrections have been made and the QC manager has inspected and approved them.
Ambient Temperature	<55°F	If physical measurements indicate that the ambient temperature is less than specified, the paving crew leader will be notified, and placement will cease as soon as safety concerns have been provided for.
Mix Temperature	<260°F	If physical measurements indicate that the mix temperature is below the temperature the paving crew leader has requested for placement and breakdown, corrective action will be taken immediately. Cool mix will be returned to the plant, the operation will be changed to correct the situation causing the problem, HMA will be held in tarped trucks and not windrowed until necessary.
In-Place Density	93%–95%	If field density determination indicates that the HMA is not being placed within the density range, immediate action will be taken, including Investigating and possibly changing roller operations, examining the mix quality after the plant is notified, or measuring temperature. Density will be tested immediately following the corrective action to verify that the action has been effective.

Appendix K Quality-Control Plan Review Checklist for Hot Mix Asphalt

Project Information	
Resident Engineer	
Contract Number	
Description	
County/Route/Post Mile	

Quality Control Plan Submittal Letter					
	Quality-Control Quality Assurance Program Overview (Letter)	Contractor checks	Complete (Yes) (engineer checks)	Incomplete (No) (engineer checks)	Comments
SL.1	Identify prime contractor				
SL.2	Identify paving subcontractor				
SL.3	Identify hot mix asphalt producer (company and plant location)				
SL.4	Identify quality control manager				
SL.5	Prime contractor's signature (the same person who signed the contract)				

Appendix K (continued) Quality-Control Plan Review Checklist for Hot Mix Asphalt

Element 1—Quality-Control Plan Certification					
Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer checks)	Incomplete (No) (engineer checks)	Comments
1.1	Quality-control plan certification				
1.1.a	Contract number				
1.1.b	Quality-control plan manager signature				

Element 2—Quality Control Organization					
Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
2.1	Organizational chart				
2.1.a	List all quality-control managers, quality-control inspectors, quality-control samplers and testers, quality-control laboratories				
2.1.b	Show how they interact and communicate				
2.1.c	Identify all by name, function and contact phone number				
2.1.d	Identify number of staff for each function				

Appendix K (continued) Quality-Control Plan Review Checklist for Hot Mix Asphalt

Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
2.1.e	Show primary and secondary person for each area of responsibility				
2.2	Quality-control staff				
2.2.a	Quality-control manager qualifications and experience				
2.2.b	Form CEM-3801, "Request for Assignment of Inspectors, Samplers, and Testers"				
2.2.b.1	Form CEM-3802, "Quality Control Inspector Affidavit of Proficiency" for each inspector				
2.2.b.2	Form TL-0111, "Qualified Certificate of Proficiency" for each sampler and tester				
2.3	Laboratories				
2.3.a	Main quality-control laboratory—IAP accreditation Form TL-0113, "Caltrans Accredited Laboratory Inspection Report"				

Appendix K (continued) Quality-Control Plan Review Checklist for Hot Mix Asphalt

Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
2.3.a.1	Name, address, phone, and email address				
2.3.a.2	Laboratory manager name and contact information				
2.3.a.3	Tests to be performed				
2.3.b	Field quality-control laboratory - IAP accreditation Form TL-0113, "Caltrans Accredited Laboratory Inspection Report"				
2.3.b.1	Name, address, phone, and email address				
2.3.b.2	Laboratory manager name and contact information				
2.3.b.3	Tests to be performed				
2.3.c	Provide nuclear gauge radioactive license if using nuclear gauges for quality control				

Appendix K (continued) Quality-Control Plan Review Checklist for Hot Mix Asphalt

Element 3—Quality Control Plan Distribution					
Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
3.1	Distribution list				
3.1.a	Locations of quality-control plans				
3.1.b	Name of person responsible for distributing quality-control plan supplements				

Element 4—Quality-Control Inspection Plans					
Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
4.1	Submit quality-control inspection plan for plant operations				
4.2	Submit quality-control inspection plan for placement operations				

Appendix K (continued) Quality-Control Plan Review Checklist for Hot Mix Asphalt

Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
5.2	Quality-control plan for sampling and testing (list quality characteristic, test method, frequency, sample location)				

Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
6.1	Submit random sampling plan, including table of random numbers				
6.2	Submit an example of the random sampling plan				

Appendix K (continued) Quality Control Plan Review Checklist for Hot Mix Asphalt

Element 7—Corrective Action Plans					
Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
7.1	Include list of anticipated corrective actions. At a minimum include:				
7.1.a	At production site: Asphalt content, aggregate gradation, aggregate moisture, mix moisture, asphalt binder temperature, aggregate temperature, mix temperature, sand equivalent, mix segregation, uncoated aggregate, mixing time, and mix storage time				
7.1.b	At placement site: Subgrade preparation, tack coat, ambient temperature, mix temperature, joint construction, thickness, placement yield, cross slope, joint offset, mix segregation, compaction testing, and smoothness.				

Appendix K (continued) Quality Control Plan Review Checklist for Hot Mix Asphalt

Element 8—Quality Control Documents					
Element Number	Quality-Control Organization	Contractor checks	Complete (Yes) (engineer check)	Incomplete (No) (engineer check)	Comments
8.1	Identify forms to be used				
8.1.a	Hot mix asphalt daily record of inspection Form CEM-3501, “Hot Mix Asphalt Production Report”				
8.1.b	Hot mix asphalt daily record of inspection Form CEM-3502, “Hot Mix Asphalt Placement Report”				
8.1.c	Hot mix asphalt daily summary of testing Form CEM-3803, “Hot Mix Asphalt Daily Summary of Testing”				
8.1.d	Hot mix asphalt inspection and testing summary Form CEM-3804, “Hot Mix Asphalt Inspection and Testing Summary”				

Appendix K (continued) Quality Control Plan Review Checklist for Hot Mix Asphalt

Quality-Control Plan Review Checklist for Hot Mix Asphalt