STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

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SUPERSEDES Sections 4-39 of February 2024, 4-40 of December 2022, 4-41 of July 2019, 4-42 of December 2022, and 6-1 of May 2024	DISTRIBUTION All Requested Manual Holders	

The purpose of this manual change transmittal is to announce updates and corrections to the Caltrans *Construction Manual.* Please note the updates, and print new sections for your manual as needed. Updated sections are published on https://dot.ca.gov/programs/construction/construction-manual and are indicated by the date listed in the right-hand column on that page. Content changes, not including edits for clarity, are enumerated:

Section 4-39, "Asphalt Concrete,"

This change adopts post-production aggregate gradation for acceptance testing of hot mix asphalt (HMA) mixtures. It replaces AASHTO T27, "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates," with AASHTO T308, "Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method," and T30, "Standard Method of Test for Mechanical Analysis of Extracted Aggregate."

Section 4-40, "Concrete Pavement"; Section 4-41, "Existing Concrete Pavement"; Section 4-42, "Groove and Grind Concrete"

This update removes CT 342, "Method of Test for Surface Skid Resistance with the California Portable Skid Tester," as an acceptance test for concrete pavement, existing concrete pavement, and groove and grind concrete. Requiring CT 342 as an acceptance test is redundant because the surface texture for concrete pavements is prescriptive in the *Standard Specifications*.

Section 6-1, "Sample Types and Frequencies"

This update removes materials acceptance sampling and testing requirements for the Coefficient of Friction test (CT 342) for concrete pavement and existing concrete pavement.

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Chapter 4 Construction Details

Section 39 Asphalt Concrete

4-3901 General

Section 39, “Asphalt Concrete,” of the *Standard Specifications* provides material and construction requirements for hot mix asphalt (HMA) including Type A, rubberized hot mix asphalt-gap graded (RHMA-G), open-graded friction course (OGFC), minor HMA, and hot mix asphalt with warm mix asphalt (WMA) additive technology. Unless WMA is specified, the term “hot mix asphalt” refers to all mixtures of aggregate and asphalt regardless of the mixing or placing temperature. Section 39 also provides construction requirements for work on existing asphalt concrete facilities.

All requirements including smoothness requirements in Section 39, except those in Section 39-3, “Existing Asphalt Concrete,” of the *Standard Specifications,* apply to all types of HMA.

Construction of Quality Asphalt Pavements (Manual Series No. 22), published for sale by the Asphalt Institute, contains information on the uses of types of asphalts and the design and production of HMA. All personnel responsible for HMA should familiarize themselves with this publication.

4-3901A Warm Mix Asphalt

WMA technologies allow production plants to produce HMA at Fahrenheit temperatures 45 degrees to 85 degrees lower than the traditional mixing temperature. Reductions in mixing temperature have the benefits of cutting fuel consumption and decreasing the production of greenhouse gases, with engineering benefits of better compaction on the road, the ability to haul paving mix for longer distances, and extending the paving season by being able to pave at lower temperatures.

WMA technologies are divided into two categories—additive technology and water injection technology, or foaming. When a WMA technology is used to aid mixing and compaction of HMA produced at reduced temperatures, it is defined as HMA with WMA technology. The contract allows that both categories of WMA technology may be used for Type A HMA, RHMA-G, and OGFC. The contract may include special provisions that require the use of WMA additive technology. When a WMA technology is used, Section 39-2.01A(1), “Summary,” of the *Standard Specifications* requires that contractors choose a technology that is on an Authorized Materials List for WMA authorized technologies.

4-3901B Rubberized Hot Mix Asphalt

RHMA is produced by mixing asphalt rubber and aggregate. Asphalt rubber is specified to include 18 percent to 22 percent crumb rubber modifier (CRM) by total

mass of the asphalt rubber blend. The CRM must also include 25 percent, plus or minus 2 percent, high natural rubber content scrap rubber by mass of the CRM that may come from scrap tires or other sources. Caltrans requires use of extender oil as an asphalt modifier in asphalt rubber. RHMA includes RHMA-G, RHMA-O, and open-graded high binder (RHMA-O-HB).

4-3901C Paving Personnel

Producing HMA pavement requires a partnership among Caltrans, the plant producing the HMA, and the contractor placing the HMA. The resident engineer must clearly communicate assignments of responsibility and commensurate authority for all Caltrans personnel, both at the job site and at the plant.

Plant inspection and testing is essential to assure quality HMA. A plant inspector at the HMA plant usually performs the inspection and testing duties for the resident engineer. However, the resident engineer is responsible for enforcing contract specifications at the plant. The resident engineer must be kept informed of test results in a timely manner so appropriate contract administration action can be taken.

The paving inspector should have completed both “Hot Mix Asphalt Basics” and “Hot Mix Asphalt Inspection” training courses before assignment as the HMA paving inspector. In addition, a paving inspector who samples material must also be qualified on California Test 125, “Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections,” Appendix D, “Bituminous Materials.”

4-3901D Hot Mix Asphalt Quality Assurance Processes

HMA is placed using 1 of 2 specified quality assurance processes: The standard process or statistical pay factor (SPF) process. The applicable quality process is defined by the item description.

For the standard process, the quality assurance requirements are defined in Sections 39-2.01, “General”; 39-2.02, “Type A Hot Mix Asphalt,” and 39-2.03, “Rubberized Hot Mix Asphalt—Gap Graded,” of the *Standard Specifications*.

For the SPF process, the quality assurance requirements are specified in Sections 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,” of the project’s special provisions.

The SPF process is typically specified on projects in which at least 10,000 tons of HMA Type-A or RHMA-G are specified. The standard process will be specified for all other cases.

4-3901D (1) Standard Quality Assurance Process

Under the standard process, the contractor performs quality control testing and Caltrans performs acceptance testing and inspection. The acceptance decision is based on Caltrans’ test results only.

For most quality control characteristics, the contractor samples and tests at a minimum frequency of once every 750 tons of produced HMA.

For Caltrans acceptance sampling and testing, test at the frequency shown in Section 6-1, “Sample Types and Frequencies,” of this manual. Under the standard process, for most tests, test a minimum of every fifth sample, but not less than once each day.

Under the standard process, HMA represented by a single failed Caltrans test is noncompliant. Each test can represent no more than 750 tons. When Caltrans’ testing or the contractor’s quality control testing indicates 2 consecutive failures of the same quality characteristics, or 3 failures of any quality characteristics, in one day, the contractor must stop production, take corrective action, and demonstrate compliance before resuming production. Noncompliant material can be accepted with a change order. For guidance on addressing noncompliant material placed using the standard process, refer to Section 4-3904A (1), “Acceptance Test Results Outside Specified Limits on Non-Statistical Pay Factor Projects,” of this manual. For guidance on stopping production because of 2 consecutive failures of the same quality characteristics or 3 failures in any quality characteristics in 1 day, refer to Section 4-3904A (2), “Two Consecutive Acceptance Test Results Outside Specification Limits on Non-Statistical Pay Factor Projects,” of this manual.

4-3901D (2) Statistical Pay Factor Quality Assurance Process

Under the SPF process, the contractor performs quality control inspection, sampling and testing. Caltrans performs verification sampling and testing. When Caltrans testing does not verify the contractor’s quality control test results, Caltrans testing is used for acceptance. Caltrans also takes an active role in inspection.

Under the SPF process, acceptance decisions are made on a lot-by-lot basis. A lot of material is typically limited to 15,000 tons of HMA. Each lot is broken into sublots of 750 tons each. A new lot starts when twenty sublots are complete, a new job-mix formula is used, or when production stops for more than 30 days. The contractor controls quality by testing at the frequency defined in the specifications. Most quality characteristics are sampled and tested once per sublot.

HMA quality has 2 general types of characteristics: pay factor quality characteristics and non-pay factor quality characteristics. The pay factor quality characteristics are used to determine acceptance and applicable payment adjustments. Acceptance and payment adjustments are based on a statistical analysis of the contractor’s verified pay factor quality control test results to determine the amount of material produced and placed within a specified limit. This value is referred to as percent within limits (PWL).

Quality of the produced and placed HMA is actively monitored during production using the contractor quality control testing of both the pay factor and non-pay factor quality characteristics.

There are 5 pay factor quality characteristics:

1. Core density, or percentage of theoretical maximum density

2. Asphalt binder content
3. Air voids at N-design gyrations
4. Percentage passing the number 200 sieve
5. Percentage passing the number 8 sieve

The remaining quality characteristics are referred to as non-pay factor quality characteristics.

Pay factor quality characteristic tests for each lot are statistically evaluated to determine the PWL after completing each sublot. If the PWL value for any of the pay factor quality characteristics falls below the defined threshold, the contractor must stop production and identify which sublots will be rejected from the lot before continuing production.

The non-pay factor quality characteristics are also continuously tested to control quality but are not used for acceptance. The non-pay factor quality characteristics are used to identify issues with production, when to require corrective action, and for stopping production when corrective actions fail as demonstrated by 2 consecutive failures of tests from 2 consecutive sublots, or when 3 failures occur in a single production shift.

Upon completion and acceptance of each lot, an incentive or disincentive is determined based on the contractor's verified PWL values. The SPF process is designated for projects with 10,000 tons or more of Type-A HMA or RHMA-G, because the incentives and disincentives encourage the contractor to implement quality controls that produce mix with higher quality standards. The incentives encourage production and use of HMA with reduced variability and at the target values designated by the approved job mix formula.

For additional guidance on the acceptance and payment adjustments, refer to Section 4-3904A (4), "Acceptance of Lots Using Statistical Pay Factor Specifications," of this manual.

4-3902 Before Work Begins

Verify that the contractor submits a job mix formula and a quality control plan (QCP) for HMA production and placement for all types of HMA. Job mix formula and QCP submittals are not required for HMA that is used for miscellaneous areas and dikes.

For HMA placed using the standard process, verify that all elements required by Section 39-2.01A(3)(c), "Quality Control Plan," of the *Standard Specifications,* are included.

For HMA placed using the SPF process, verify the QCP is prepared in accordance with the *Quality Control Manual for Hot Mix Asphalt Using Statistical Pay Factors.* Use the manual's checklist in Appendix K to assist with review of the QCP. The manual is available at:

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

The contractor's laboratories used for testing aggregate and HMA qualities for determining the job mix formula and the independent third-party laboratory performing dispute resolution testing must be qualified under the American Association of State Highway and Transportation Officials (AASHTO) re:source program and the Caltrans' Independent Assurance Program (IAP). For the standard process, the contractor's quality control laboratory is not required to be certified by re:source but is required to be certified by Caltrans' IAP, if the tests are used for acceptance. For the SPF process, the contractor's quality control laboratory is required to be certified by IAP and certification by AASHTO is recommended, because the tests are used for acceptance. IAP certification is achieved through the Joint Training and Certification Program.

For test results to be used for acceptance or to dispute a quality assurance result, the lab must be qualified for independent assurance. AASHTO re:source is highly encouraged but not required.

HMA plants must comply with the *Material Plant Quality Program* (*MPQP*) manual guidelines. The manual may be found here:

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

4-3902A General

Before the work begins, the resident engineer will:

- Determine the type of HMA specified for the project, the specification process, and review the plans and the special provisions. The special provisions specify the type of HMA, aggregate size, and asphalt binder grade.
- Review the project specifications' measurement and payment clauses and determine what records must be kept.
- The job mix formula requirements are the same for the standard and SPF specification processes.

4-3902B Job Mix Formula Submittal

Review the documents in the contractor's job mix formula submittal information to verify they are complete. Notify the contractor immediately if the submittal is incomplete. Include:

- Form DOT CEM-3511, "Contractor Job Mix Formula Proposal," which documents target values for aggregate sieves, percent of asphalt binder, and source information for all HMA component materials. If applicable, Form DOT CEM-3511 will also include the percentage of recycled asphalt pavement and antistrip treatment method.
- Form CEM-3512, "Contractor Hot Mix Asphalt Design Data," which documents the testing data developed by the mix design laboratory. If Form CEM-3513, "Caltrans Hot Mix Asphalt Verification," is not attached, the completed mix design data Form CEM-3512 must have been dated within the past 24 months.

- Form CEM-3513, “Contractor Hot Mix Asphalt Verification,” if submitted, documents Caltrans’ verification test results for the proposed job mix formula. Form CEM-3513 must have been signed by an engineer, preferably the district materials engineer, within 24 months of the start of planned HMA production.
- Safety data sheets in accordance with Section 39-2.01A(3)(b), “Job Mix Formula,” of the *Standard Specifications*.

4-3902C Job Mix Formula Review

The resident engineer must:

- Review the contractor’s proposed job mix formula submitted on Form DOT CEM-3511, “Contractor Job Mix Formula Proposal,” for compliance with Section 39-2, “Hot Mix Asphalt,” of the *Standard Specifications* and additional requirements in the special provisions. Notify the contractor immediately if the proposed job mix formula does not comply with the specifications.
- Review the contractor’s proposed job mix formula submitted on Form DOT CEM-3511, and verify the asphalt binder supplier is on the Caltrans list of approved suppliers at:

  https://mets.dot.ca.gov/aml/AsphaltBindersList.php

  If the asphalt binder supplier is not on Caltrans’ list of approved suppliers, notify the contractor that asphalt binder supplied for the project must comply with the Division of Engineering Services Asphalt Supplier Prequalification Program. Visit this page for information on qualifying:

  https://dot.ca.gov/-/media/dot-media/programs/engineering/documents/mets/program-guidelines-a11y.pdf
- If WMA technology, either additive or water injection foam, or crumb rubber modifier is used, verify it is on the applicable Caltrans Authorized Materials List at:

  https://dot.ca.gov/programs/engineering-services/authorized-materials-lists
- If the submitted job mix formula proposal complies with the specifications, notify the contractor within 5 days of submittal that:
  - The job mix formula is accepted if Form CEM-3513, “Caltrans Hot Mix Asphalt Verification,” was issued within 24 months of proposed HMA production. The resident engineer signs and returns Form DOT CEM-3511.
  - The job mix formula must be verified if Form CEM-3513 was not issued within 24 months of proposed HMA production. The resident engineer requests that the contractor give notice when HMA will be produced for verification and notifies the district materials engineer.
  - For open-graded friction course HMA, if Form CEM-3513 was not issued within 24 months of proposed HMA production, the resident engineer requests that the contractor give notice for sampling of aggregate, binder, and additives.

4-3902D Job Mix Formula Verification

4-3902D (1) General

The contractor takes the following steps related to job mix formula verification for all types of mixes.

If the proposed job mix formula has not been verified within 24 months of production, the contractor must furnish material samples in accordance with Section 39-2.01A(3)(b), "Job Mix Formula," of the *Standard Specifications*, including:

- Coarse, fine, and supplemental aggregate from stockpiles, cold feed belts, or hot bins. Samples must include at least 120 pounds for each coarse aggregate, 80 pounds for each fine aggregate, and 10 pounds for each type of supplemental fines.
- Recycled asphalt pavement from stockpiles or recycled asphalt pavement system, if used. Samples must be at least 60 pounds.
- Asphalt binder from the binder supplier. Samples must be in 2, 1-quart cylindrical cans with open top friction lids.
- Asphalt rubber binder with the components blended in the proportions to be used. Samples must be in 4,1-quart cylindrical cans with open top friction lids.
- Antistrip additives, if used.

The resident engineer's verification process includes:

- Receiving notification from the contractor at least 2 business days before sampling material so that an inspector may be present during the sampling.
- Witnessing the contractor sampling HMA and component materials.
- Shipping the samples immediately to the district materials laboratory. They will be processed according to the instructions included on Form TL-0101, "Sample Identification Card." The TL-0101 should be marked Priority and include Job Mix Formula Verification Sample under Remarks.
- Providing job mix formula verification results to the contractor on Form CEM-3513, "Caltrans Hot Mix Asphalt Verification," within 20 days of receiving all samples.

4-3902D (2) Verification Process for Open-Graded Friction Course

For samples of aggregate, asphalt binder, and additives, if applicable:

- Request that the district materials lab determine if the aggregates comply with the contract quality requirements.
- Request that the district materials laboratory determine asphalt binder content under California Test 368, "Method of Test for Optimum Bitumen Content (OBC) for Open Graded Friction Course."

- Within 20 days of material sampling, Caltrans will determine asphalt binder content and provide the contractor with Form CEM-3513, “Caltrans Hot Mix Asphalt Verification.”
- Within 20 days of receipt of a complete job mix formula submittal and material sampling, the resident engineer signs and returns the accepted or rejected job mix formula on Form DOT CEM-3511, “Contractor Job Mix Formula Proposal,” with Form CEM-3513 attached, to the contractor immediately following receipt of Form CEM-3513 from the district materials laboratory.

4-3902D (3) Verification Process for Type A and Rubberized Hot Mix Asphalt-Gap Graded

If the contractor’s job mix formula proposal has not been verified, the contractor must provide aggregate and HMA verification samples from the plant that will be used for the project. The contractor samples in accordance with California Test 125, “Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections.”

Samples are obtained at the following locations:

- Aggregates are sampled from cold feed belts or hot bins.
- Recycled asphalt pavement, if used, is sampled from the recycled asphalt pavement system.
- HMA is sampled at the plant, in a truck, from a windrow, the paver hopper, or on the mat behind a paver.

Test verification samples for compliance with the specifications. Refer to Section 39-2.01A(4)(b), “Job Mix Formula Verification,” of the *Standard Specifications*.

Make sure the proposed job mix formula is verified by the district materials laboratory within 20 days of sampling HMA or when requested in writing by the contractor within 3 business days for rubberized HMA. Verification is complete after the district materials engineer completes and returns Form CEM-3513, “Caltrans Hot Mix Asphalt Verification,” to the resident engineer. Form DOT CEM-3511, “Contractor Job Mix Formula Proposal,” must also be completed by the resident engineer and returned to the contractor along with Form CEM-3513 within this time frame.

For HMA using WMA technology:

- Obtain the result and a tested sample set for AASHTO T 324, “Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures,” from the contractor.
- Verify the HMA compliance with the mix design requirements for both AASHTO T 324 and AASHTO T 324 (Modified).
- Verify RHMA-G-WMA quality requirements within 5 business days.

4-3902D (4) Unverified Proposed Job Mix Formula

If the district materials laboratory does not verify the proposed job mix formula:

- The resident engineer notifies the contractor in writing on Form DOT CEM-3511, "Contractor Job Mix Formula Proposal," of the rejected job mix formula, attaching Form CEM-3513, "Caltrans Hot Mix Asphalt Verification," with Caltrans' verification test results.
- The contractor may submit a new job mix formula on Form DOT CEM-3511 with a new Form CEM-3512, "Contractor Hot Mix Asphalt Design Data," or the contractor may adjust the job mix formula on Form DOT CEM-3511 with allowable adjustments specified in Section 39-2.01A(4)(b), "Job Mix Formula Verification," of the *Standard Specifications*.
- If the contractor disputes Caltrans' verification test results, make sure the contractor complies with Section 39-2.01A(4)(i)(iv), "Dispute Resolution," of the *Standard Specifications.*

4-3902D (5) Adjusted Job Mix Formula

The contractor may adjust the job mix formula to meet the specifications. Justification for any adjustments outside the target values shown on Form CEM-3512, "Contractor Hot Mix Asphalt Design Data," must be listed on the modified Form DOT CEM-3511, "Contractor Job Mix Formula Proposal."

If the adjusted job mix formula proposal complies with the specifications, arrange with the contractor a time to witness the sampling of plant-produced HMA.

Make sure that the proposed job mix formula is verified by the district materials laboratory within 20 days of sampling HMA or when requested in writing by the contractor or within 3 days of sampling rubberized HMA. Verification is done when the district materials engineer completes and returns Form CEM-3513, "Caltrans Hot Mix Asphalt Verification," to the resident engineer. Form DOT CEM-3511 must also be completed by the resident engineer and returned to the contractor with Form CEM-3513 within 20 days of sampling HMA.

If the district materials laboratory does not verify the adjusted proposed job mix formula, notify the contractor in writing on Form DOT CEM-3511 and attach Form CEM-3513 with Caltrans' verification test results.

If the adjustment failed to resolve the job mix formula verification problem, the contractor may propose a new job mix formula or dispute Caltrans' test results in accordance with Section 39-2.01A(4)(i)(iv), "Dispute Resolution," of the *Standard Specifications*.

4-3902E Job Mix Formula Renewal

Job mix formula approval is good for 24 months. The contractor may request a job mix formula renewal before expiration of the approval.

Verify that the contractor takes the following steps for job mix formula renewal:

- Submits the proposed job mix formula on Form DOT CEM-3511, “Contractor Job Mix Formula Proposal,” attaching the previously verified job mix formula on Form CEM-3513, “Caltrans Hot Mix Asphalt Verification,” and the mix design information for previously verified job mix formula on Form CEM-3512, “Contractor Hot Mix Asphalt Design Data.”
- Notifies the resident engineer before sampling materials.
- Samples materials at the locations and quantities shown in Section 4-3902D, “Job Mix Formula Verification,” of this manual. HMA must be sampled at the location approved in writing by the resident engineer.
- Submits Form CEM-3514, “Contractor Job Mix Formula Renewal.” Contractors use Form CEM-3514 to submit to the resident engineer their test results for renewal of HMA job mix formula.

The resident engineer’s job mix formula renewal process includes:

- Reviewing the proposed job mix formula on Form DOT CEM-3511. Refer to Section 4-3902C, “Job Mix Formula Review,” of this manual. If the submitted job mix formula proposal complies with the specifications, the resident engineer notifies the contractor within 5 days that split-sampled HMA and component materials must be provided.
- Witnessing the contractor sampling HMA and component materials. Take possession of the material samples and hold until receiving contractor test results.
- Reviewing the information on Form CEM-3514 to confirm that the contractor test results comply with the specifications. When the test results indicate that the sampled and tested HMA complies with the specification, request that the district materials laboratory perform HMA verification testing.
- Shipping material samples to the district materials laboratory if the contractor’s test results on Form CEM-3514 comply with the specifications. Samples will be processed according to the instructions on Form TL-0101, “Sample Identification Card.” The TL-0101 should include Job Mix Formula Renewal Verification Sample under Remarks.
- Providing job mix formula verification results to the contractor on Form CEM-3513 within 30 days of receiving Form CEM-3514 from the contractor.

4-3902F Job Mix Formula Acceptance

Job mix formula acceptance requires the resident engineer to review and accept submitted Form DOT CEM-3511, “Contractor Job Mix Formula Proposal,” with Form CEM-3512, “Contractor Hot Mix Asphalt Design Data,” and an accepted Form CEM-3513, “Caltrans Hot Mix Asphalt Verification,” attached. Refer to Section 4-3902C “Job Mix Formula Review,” of this manual for guidelines on reviewing Form DOT CEM-3511.

4-3902G Plant Operations

HMA plants must be qualified under the *MPQP*. Refer to Section 3-902E, "Weighing Equipment and Procedures," of this manual for additional information.

Before production begins, take the following steps related to HMA plant operations:

- Verify with the district weights and measures coordinator that the proposed HMA plant and production equipment for performance grade modified asphalt binder with CRM is Caltrans-qualified under the *MPQP*. Batch HMA plants must be qualified annually, and continuous HMA plants must be qualified at least every 6 months, in accordance with Section 1-1.04, "Frequency," of the *MPQP* manual.
- If the HMA plant is not qualified, notify the contractor in writing and provide the contact information for the district weights and measures coordinator. The contractor must give the district weights and measures coordinator 5 business days' notice to schedule HMA plant qualification.
- Accept HMA for as long as 14 days from a nonqualified plant if start-up approval has been granted in writing by the district weights and measures coordinator.

4-3902H Antistrip Treatment of Aggregates

HMA may be sensitive to moisture damage and require antistrip treatments. The treatment method can be either lime treatment, by dry lime, dry lime with marination, or lime slurry with marination, or liquid antistrip. Regardless of the type of antistrip treatment chosen by the contractor, the HMA must meet the requirements of AASHTO T 283, "Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage," and AASHTO T 324, "Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures."

When the contractor chooses to use antistrip treatment of aggregate, the contractor must test the proposed HMA aggregate blend for plasticity index in accordance with California Test 204, "Method of Tests for Liquid Limit, Plastic Limit, and Plasticity Index of Soils." When California Test 204 indicates clay is present in the aggregates, the plasticity index is used to determine the type of antistrip treatment. Refer to Section 39-2.01B(2)(b) "Hot Mix Asphalt Treatments," of the *Standard Specifications* for the treatment method allowed.

4-3902H (1) Lime Treatment of Aggregates

There are two methods for lime treatment of aggregates:

- Hot mix asphalt aggregate lime treatment—slurry method
- Hot mix asphalt aggregate lime treatment—dry lime method

Using the slurry method, treated aggregates are always marinated. Under the dry lime method, if the plasticity index is 4 through 10, aggregates must be marinated. When marination is required, the lime-treated aggregate must be stockpiled for 24 hours to 60 days before using in HMA.

Recycled asphalt pavement used in the production of HMA does not need to be lime treated.

Quality characteristic acceptance test limits for aggregate properties are based on untreated aggregates. Therefore, aggregate quality control and acceptance testing must be performed on aggregate samples taken before lime treatment.

During lime treatment, the sand equivalent test is used to signal a change in the presence of clays. If sand equivalent values decrease significantly, the plasticity index of the aggregate blend must be tested to verify that it continues to be in the acceptable range listed in the special provisions.

If clays are present in the aggregate blend, both lime treatment methods must be followed by marination.

For lime-treated aggregates, before lime treatment begins, take the following steps:

- Verify with the district weights and measures coordinator that the proposed lime treatment plant is Caltrans-qualified in accordance with the *MPQP.*
- Verify the lime proportions for the fine and coarse aggregate or for the combined aggregates shown on the job mix formula.

During lime treatment, take the following steps:

- Obtain aggregate samples from stockpiles in accordance with California Test 125, “Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections,” to field test for moisture content and sand equivalent at the frequency shown in Table 6-1.13., “Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete,” in Section 6-1, “Sample Types and Frequencies,” of this manual.
- Test aggregate samples for sand equivalent at the frequency shown in Table 6-1.13. of this manual. Combine aggregate from individual stockpiles in the job mix formula proportions to test for sand equivalent. If the sand equivalent test result exceeds the specified limits, immediately notify the resident engineer.
- It is good practice to test aggregate samples for moisture content in accordance with AASHTO T 255, “Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying,” or AASHTO T 329, “Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method,” because moisture influences proportioning. The plant inspector should confirm that the contractor is performing sampling and testing for moisture content at a frequency shown in Section 39-2.02A(4)(b)(ii), “Aggregates,” of the *Standard Specifications*.
- Obtain aggregate samples from stockpiles or aggregate belts before lime treatment, in accordance with California Test 125. Sample aggregates at the frequency shown in Table 6-1.13. of this manual for aggregate acceptance testing.

  Label each aggregate sample with the contract number, date, type of mix, aggregate gradation, for example, 1/2-inch, aggregate source, HMA producer, and producer’s mix identification number. Indicate the number of tons produced when the sample was taken.

- Test aggregate at the frequency shown in Table 6-1.13. For samples that will be shipped to the district material laboratory or field construction laboratory for testing, complete Form TL-0101, “Sample Identification Card.” Follow the instructions printed in the accompanying booklet and the information in Section 6-103, “Field Sampled Material Identification for Testing,” of this manual. Record the type of mix, the HMA producer, and the producer’s mix identification number. Check the acceptance tests box on the TL-0101. Under Remarks, identify the tests to be performed:

  1. Los Angeles Abrasion Testing
  2. Percentage of crushed particles coarse aggregate
  3. Percentage of crushed particles fine aggregate
  4. Fine aggregate angularity
  5. Flat and elongated particles
  6. Other aggregate properties specified in the project special provisions, if applicable

  If any test results exceed the specified limits, the materials laboratory will immediately notify the resident engineer.
- Verify that the aggregate treatment is adequate by witnessing contractor quality control testing, and be sure the contractor enters into a log the treatment data specified in the special provision.

  For each day of aggregate lime treatment, obtain the treatment data log in electronic format for the resident engineer’s project files.

4-3902H (2) Marination of Lime-Treated Aggregates

Marination of the lime-treated aggregates must be done when required in the special provisions or when California Test 204, “Method of Tests for Liquid Limit, Plastic Limit, and Plasticity Index of Soils,” indicates that the plasticity index is 4 through 10.

Lime-treated aggregate must marinate at least 1 day and no more than 60 days before use in HMA production. If rain is anticipated during the marination period, the contractor must protect the stockpiles. If the lime-treated aggregate has been exposed to rain, inspect the stockpiles. If aggregate lime coating has been damaged significantly, reject the aggregate. If only the outside surface of the stockpile has been damaged, require that the contractor remix the piles to redistribute the lime.

4-3902H (3) Liquid Antistrip Treatment

This treatment process requires the addition of the liquid antistrip to asphalt binder during HMA production.

Before production begins, take the following steps:

- Verify with the district weights and measures coordinator that the proposed liquid antistrip metering device and storage tank are Caltrans-qualified under the *MPQP*.

- Verify that the liquid antistrip is the same type and brand as shown on the accepted job mix formula.

4-3902I Prepaving Conference

Before work begins, the resident engineer holds a prepaving conference with the contractor to discuss HMA production and placement:

- Review the accepted job mix formula and check that Form CEM-3513, “Caltrans Hot Mix Asphalt Verification,” has been signed by Caltrans within the past 24 months.
- Confirm that the accepted job mix formula has not changed.
- Discuss with the contractor what atmospheric and pavement temperatures the contractor has chosen that would result in a notification to stop production of HMA at the plant.
- Discuss method of incorporating WMA technology.
- Discuss with the contractor pavement areas to receive tapered edge and construction methods to be used.
- Discuss with the contractor pavement areas to receive shoulder backing and construction methods to be used.
- If crumb rubber modifier is to be used, discuss the requirement that the crumb rubber usage reports are submitted monthly and at the end of the contract.
- Verify if the contractor intends to use a tapered notch wedge device to construct the longitudinal joint. A tapered notch wedge can be used only on a divided highway and when the special provisions do not include a requirement that adjacent traveled-way lanes be squared up from 5 feet to 10 feet at the end of each work shift.
- Discuss the minimum taper requirements for temporary joint tapers when a transverse joint greater than 0.04 foot cannot be avoided before opening to traffic.
- Verify that the type of spreading equipment proposed by the contractor has the necessary attributes for the project. Permit wing-type spreading equipment only for areas not requiring an asphalt paver, and then only for such widths, typically less than 5 feet, that will not adversely affect the surfacing on the traffic lane.
- Verify that rollers have the specified attributes. For method process, make sure the specified number of rollers will be used based on the type of HMA being placed.
- For SPF projects, discuss the requirement that the resident engineer and contractor’s quality control manager use copies of a common spreadsheet to enter and evaluate quality control test data from each lot. Discuss the requirement that the contractor enter test data after each sublot and export the data and submit it daily to the resident engineer. The engineer does not share verification data until completion of the lot.

- Where the SPF process is specified, discuss the requirement that both the contractor and Caltrans sample using their own stratified random sampling plans. Contractors sample randomly from each sublot in accordance with the random plan included in their quality control plan. Caltrans obtains verification samples as defined in the Caltrans stratified random sampling plan. For guidance on developing the engineer's stratified random sampling plan, refer to section 4-3902K, "Stratified Random Sampling Plan" of this manual.
- When the SPF process is specified, discuss the requirement that Caltrans not share its stratified random sampling plan or verification test results with the contractor until the contractor submits all quality control test data for the completed lot.
- When the SPF process is specified, discuss the 3-day look-ahead HMA production and paving schedule submittal. This submittal is required to communicate HMA production and paving schedules to the Caltrans samplers to facilitate the scheduling of their verification sampling. The 3-day look-ahead schedule must be submitted after completing each shift and include the following items for each of the next 3 paving shifts:

    1. Contract number
    2. Job mix formula number
    3. HMA plant location
    4. Paving location; including county, route number and approximate postmiles
    5. Lot and sublot numbers planned to be placed each shift
    6. Total tonnage planned to be produced each shift including start and finish times of production

    When the standard process is specified, discuss the requirement to pull density cores from random locations determined by the engineer and that cores must be pulled in the engineer's presence and provided to the engineer at least once every 5 business days.
- When the SPF process is specified, discuss the requirement to pull contractor quality density cores from locations defined in the contractor's random sampling plan, and to pull verification cores where defined in the engineer's stratified random sampling. The contractor will take possession of the cores used for quality control testing, and the engineer will take possession of the cores used for verification testing and potential independent assurance testing. Discuss the requirement that both parties not locate the random core locations until after completing the compaction operations.
- If there is a bid item for data cores, discuss the requirements for pulling the data cores and the requirements for submitting the data core summary and photographic record to the engineer and Coring@dot.ca.gov.

- Discuss the contractor's method to produce smooth pavement that meets the specifications.
- If cold planing is required, discuss the requirement that the cold planer be equipped with automatic controls, such as a ski device or averaging system. Discuss what practices will be used to promote a smooth cold-planed surface. For requirements, refer to Section 39-3.04C(2), "Grade Control and Surface Smoothness," of the *Standard Specifications*.
- Discuss how smoothness quality control will be accomplished.
- Discuss the requirements for submitting smoothness submittals to the secure file sharing system and for registering for the secure file sharing system by sending an email to Asphalt.Smoothness@dot.ca.gov.
- If the contract includes prepaving grinding:
    1. Emphasize that prepaving grinding work is only applicable to existing asphalt concrete surfaces that have not been cold planed or replaced.
    2. Remind the contractor that replaced asphalt concrete surfacing must meet the 12-foot straightedge specification. Corrective grinding on replaced asphalt concrete surfacing is part of the replace asphalt concrete surfacing work, not part of the prepaving grinding work.
- Discuss how corrective grinding locations will be determined, whether the contractor will use the ProVAL smoothness assurance module or an alternate method. Refer to Section 4-3602C, "Pavement Smoothness," of this manual, for additional information on ProVAL computer software.
- Discuss how locations identified in inertial profiles will be located in the field. Will the contractor be laying out locations using distance measurement instrumentation (DMI) tied to the beginning of the project, DMI measurement from intermediate fixed locations tied to "events" in the inertial profile, inertial profile stationing converted to global positioning system coordinates, or a combination of methods?
- Determine early if the contractor plans to perform inertial profiling as a means to control quality of smoothness or when the paving is completed.
- In areas where smoothness must meet the 12-foot straightedge requirement, discuss if the contractor will have a straightedge available, and who on the paving crew is responsible for using it.
- Suggest use of a rolling straightedge device for comparison in ProVAL, which will assist in identifying locations that should physically be checked with a 12-foot straightedge.
- Discuss contingency plans to minimize or eliminate delamination of cold-planed surfaces. Discuss what criteria and methods will be used to identify and record locations where the contractor and engineer mutually agree may reflect through to the final surface.

- Discuss the contractor's plans for determining where corrective grinding will occur on the final surface.
- Discuss the contractor's plans for scheduling paving after cold planing to meet the time requirements specified in Section 39-3.04, "Cold Planing Asphalt Concrete Pavement," of the *Standard Specifications.*
- Discuss the contractor's plans for assuring that material transfer vehicles (MTV), or other types of heavy paving equipment that exceed the California Vehicle Code, Division 15, "Size, Weight, and Load," weight limits for vehicles on highways, are prevented from crossing a structure without written authorization. The authorization may be from Caltrans Transportation Permits office or from the engineer. Requests for authorization are subject to a 15-day review.
- Determine the type of tack coat the contractor has chosen to use, based on expected atmospheric conditions, tack coat material type availability, and local experience. Discuss the requirement to submit calculations for minimum spray rates required to achieve the minimum residual rate before the tack coat is applied. Also, discuss how far in advance of the paving operation the tack coat will be placed. For additional information about tack coats and the website for *Tack Coat Guidelines*, refer to Section 4-3908A, "References," of this manual, and to the *Minimum Tack Coat Spray Rates* at:

  https://dot.ca.gov/programs/construction/hot-mix-asphalt-construction
- Emphasize that public traffic will not be allowed on pavement with tack coat and discuss how the contractor will apply additional tack coat to damaged areas immediately before placing HMA.
- Confirm that the trucks used for tack coat application have the specified attributes. For distributor attributes, refer to Section 37-1.03B, "Equipment," of the *Standard Specifications*.

Discuss:

- The contractor's quality control plan.
- The contractor's communication between the quality control manager and production and placement personnel.
- How the contractor will transmit required quality control testing reports.
- How the resident engineer will transmit required acceptance test results.

With the contractor, discuss who has responsibility in the field to:

- Monitor HMA temperatures.
- Monitor atmospheric temperatures.
- Monitor pavement temperatures.
- Direct HMA truck drivers when loads must be tarped.
- Define the length of windrow, if applicable.
- Direct the HMA plant to slow or stop loading trucks because of truck queuing.

- Stop production when 2 consecutive quality control test results do not comply with the specifications, or when 3 in a single day do not comply with the specifications as applied to:
    1. All quality characteristics of HMA placed using the standard process. For guidance on standard process projects, refer to Section 4-3904A (2), "Two Consecutive Acceptance Test Results Outside Specification Limits on Non-Statistical Pay Factor Projects" of this manual.
    2. Non-pay factor quality characteristics of HMA placed using the SPF process. For guidance on the SPF process, refer to Section 4-3904A (5), "Monitoring Non-Pay Factor Quality Characteristics using Statistical Pay Factor Specifications" of this manual.

Stop production on SPF projects when any pay factor except the number 8 sieve falls below 0.90. Stop production if the pay factor for the number 8 sieve falls below 0.75.

Discuss the type of action that will be taken by the contractor when:

- The HMA plant shuts down unexpectedly.
- The HMA paver breaks down.
- The HMA compaction equipment breaks down.
- Atmospheric or pavement temperature drops.

Make sure that the contractor has coordinated any necessary cold-planing operations; signs for construction area drop-offs, shoulder, and uneven pavement; and temporary pavement delineation, if applicable.

Review with the contractor the production start-up evaluation requirements for the first 750 tons of mix. Except for AASHTO T 324 (Modified), "Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures," and AASHTO T 283, "Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage" test results, the contractor and engineer must report test results within 5 business days of sampling, and for AASHTO T 324 (Modified) and AASHTO T 283 test results within 15 days of sampling.

4-3902J Paving Operations

Before work begins, take the following steps related to HMA paving operations:

- Review *Construction of Quality Asphalt Pavements (Manual Series No. 22)*, published by the Asphalt Institute.
- Make sure that the subgrade has been prepared as specified. If any HMA leveling is required to smooth an existing irregular surface, inform the contractor and determine the method of payment.
- Determine if crack sealing or dig outs that remove and replace existing pavement are required to repair small areas. When contract items are not included, inform the contractor of any extra work for crack sealing or dig outs.

- Review the contractor's accepted quality control plan.
- If resurfacing under structures will result in reduced clearance, follow the procedures in Section 3-703B, "Permanent Clearance and Bridge Permit Rating Changes," of this manual.
- Verify that personnel who will be taking mat acceptance samples and witnessing core sampling are qualified for California Test 125, "Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections."
- Coordinate requests for authorization for a vehicle exceeding the weight limits established by California Vehicle Code, Division 15, "Size, Weight, and Load," to cross a structure with the project's structure representative. If the project has not been assigned a structure representative, coordinate the review with the bridge construction engineer. Structure Construction personnel will review the overload proposal in accordance with Bridge Construction Memo A-1, "SC Staff Responsibilities for Processes Owned by Others"; Attachment 2, "SC Staff Responsibilities for Performing Standard Construction Activities," and Section 1-17, "Control of Work – Maintenance and Protection – Load Limits," of the *Bridge Construction Records and Procedures Manual, Vol. 1.*

4-3902K Stratified Random Sampling Plan

For HMA placed using the SPF process, develop a stratified random sampling plan to predefine your verification sampling milestones for each of the 5 pay factor quality characteristics. For a general discussion on the purpose of this plan, refer to Section 4-3901D, "Hot Mix Asphalt Quality Assurance Processes," of this manual.

Use the spreadsheet titled "Caltrans Stratified Random Sampling Plan" available at:

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

Obtain verification samples reasonably close to the milestone locations defined in the random sampling plan. When a verification sampling milestone is missed, document the reason, the difference in tonnage, and steps taken to pull a replacement random sample free of intentional or unintentional bias.

Keep your stratified random sampling plan and the verification test results confidential until completion of the lot. You may share the results of the non-pay factor quality characteristics test results with the contractor at any time. If you share gradation results, do not share the percentage passing the number 8 or number 200 sieves because they are pay factor quality characteristics.

If a lot runs short of the planned quantity and there are fewer than 3 verification samples, then when there is a previous lot using same JMF, combine tests with the previous lot, and verify the short lot using the test results from both lots. Once verified, adjust each lot based on its own contractor quality control test results. If there is no previous lot using the same JMF, use test results from the next 5 sublots on the following lot. Once verified, adjust each lot based on its own contractor quality control test results.

When neither of preceding options is viable to obtain at least 3 verification test results, test randomly selected remaining verification samples that are not reserved for future independent third-party dispute resolution testing.

For field compaction verification, report the day's theoretical maximum density using the average of 2 tests from 1 split of a single sample pulled at a random time during the shift the verification core is pulled. Do not attempt to time the sampling of the HMA with the locations the cores are to be obtained. Randomly locate 3 density cores aligned longitudinally 1 to 2 feet apart from each 250-ton part of a randomly determined 750-ton contractor sublot. Retain 2 cores, 1 for verification testing and 1 for independent third-party testing. Provide the third core to the contractor. The contractor may not use this core as part of their reported quality control testing.

Determine the percentage of theoretical maximum density of each of verification core using the core density and the theoretical maximum density determined from the date the HMA was placed at the site of the core. Do not use average theoretical maximum density determined from previous shifts. Report the percentage of theoretical maximum density of the verification test as the average of the 3 "percent of theoretical maximum density" values determined from the 3 cores.

4-3903 During the Course of Work

4-3903A General

Quality production and placement of HMA requires a quality assurance process that consists of quality control by the contractor and acceptance by Caltrans. While some of these functions may seem redundant, each serves a separate purpose.

The contractor is responsible for providing a quality control plan (QCP). Verify that the contractor follows the QCP, and when required, makes any necessary changes to the QCP.

4-3903A (1) Quality Control

Quality control, sometimes called process control, is the testing performed by the contractor to make sure that the HMA being produced or placed meets the requirements of the specifications. Quality control testing of aggregates and HMA quality characteristics must be performed at a specified minimum frequency. Sampling should be performed at locations such as plant, windrow, or mat to assure that quality control test results are not influenced by sampling location. Sampling must be random and must not be split samples of Caltrans' acceptance or verification samples.

The contractor will want to know early on how closely the contractor's quality control test results replicate the quality acceptance test results. The job mix formula verification and production start-up evaluation both offer early opportunities for the contractor to compare quality control test results with acceptance test results. Unlike the comparison of contractor's quality control and Caltrans' acceptance test results during production and placement, the verification and production start-up evaluation

test results are on the same split samples. Therefore, the results are a direct measure of the variation between the laboratories.

The contractor performs quality control testing for asphalt rubber binder, gradation, and fabric content of crumb rubber modifier; aggregate and recycled asphalt pavement moisture; and recycled asphalt pavement gradation and binder contents.

4-3903A (1a) Hot Mix Asphalt Density

The contractor is required to conduct quality control testing regularly. The specifications give required intervals in the quality control table of the specifications. If the total layer thickness is at least 0.15 foot, the contractor is required to conduct density testing. Do not allow the contractor to break a layer thickness of a single type of HMA into lifts less than 0.15 feet.

Under the standard process, the contractor is required to perform quality control density testing using a nuclear gauge that has been calibrated to cores taken on the first day of production.

Under the SPF process, the contractor is required to perform quality control density testing in accordance with the contractor's approved quality control plan.

Under both standard and SPF specifications, if the total layer thickness is less than 0.15 foot, the contractor must follow the requirements of the method process listed in Section 39-2.01C(15)(b), "Method Compaction," and the "Construction" sections of the applicable type of HMA: 39-2.02C for Type A; 39-2.03C for RHMA-G; or 39-2.04C for OGFC, of the *Standard Specifications.*

4-3903A (1b) Method Process

The contractor must comply with the specifications for placement, such as temperature and roller requirements. Depending on the type of HMA, the minimum compaction's temperatures may be reduced when WMA additive technology is used, but not when WMA water injection technology is used. Caltrans' inspection process should include documenting and reporting surface temperatures and roller passes to assure that compaction operations meet the method specification requirements.

4-3903A (2) Department Acceptance

Department, that is Caltrans, acceptance of HMA consists of material acceptance testing and both plant and paving inspection. The resident engineer is responsible for coordinating necessary field personnel and taking contract administration action when required. Verify that Caltrans personnel who sample or test have met the requirements of the Caltrans Independent Assurance Program and are qualified to perform the sampling or testing. For more information, go to:

https://dot.ca.gov/programs/engineering-services/independent-assurance-program

Material acceptance sampling frequencies and material acceptance testing frequencies, shown in Table 6-1.13. of this manual, are not the same. Caltrans limited the risk to the contractor by specifying in Section 39, "Asphalt Concrete," of

the *Standard Specifications* that no single test result may represent more than the smaller of 750 tons or one day's production, whichever is less, except AASHTO T 283, "Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage," and AASHTO T 324 (Modified), "Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures." Therefore, during the work, it is important to split all acceptance sample materials. Use one sample for acceptance testing and one for dispute resolution.

Test the samples in a field construction laboratory or ship them to a district materials laboratory to be tested at the minimum testing frequency shown in Section 6-1, "Sample Types and Frequencies," of this manual. Store the remaining samples in case additional acceptance testing is necessary.

When HMA is produced and placed using the standard process, the contractor may request that the resident engineer split acceptance samples. If requested, split acceptance samples into 4 parts: test 1, provide 1 to the contractor, and store 2 for dispute resolution.

When HMA is produced and placed using the SPF process, the sampling requirements for pay factor and non-pay factor quality characteristics differ.

For pay factor quality characteristics, always split verification samples into 4 parts: test 1, provide 1 to the contractor when requested, and retain 2 for dispute resolution.

For non-pay factor quality characteristics, always pull at least 2 samples from 2 consecutive sublots. Split each of the 2 samples into 4 parts, keep 2 parts, provide 1 part to the contractor and provide 1 part to the independent third party.

Dispute resolution testing of the first of 2 consecutive non-pay factor samples is optional and can be requested by the contractor or the engineer, but must be requested before the engineer starts testing of the first sample. Dispute testing on the second of the 2 consecutive samples is always required, but testing is only performed when the first sample fails.

When dispute resolution testing on either the first or second of the 2 consecutive non-pay factor quality characteristics samples is performed, the engineer, contractor and independent third party are required to test their splits of the sample. The sample is considered failed when 2 of the 3 split samples fail or when the engineer's split sample fails and any of the remaining 2 split samples tests are not yet reported.

Refer to section 4-3904A (5), "Monitoring Non-Pay Factor Quality Characteristics Using Statistical Pay Factor Specifications," of this manual for guidance on this dispute resolution process.

When dispute resolution testing is required on a non-pay factor quality characteristic sample, and only 1 of the engineer's or independent test results indicates a failure, and contractor's test results are not submitted in a reasonable amount of time, direct the contractor to stop production until a passing test result is submitted.

On standard and SPF process contracts, quality assurance must be performed regularly, and verification and acceptance tests must be processed in a timely fashion. The resident engineer must make every effort to conduct the necessary

inspection, make sure that sampling and testing staff are available, and have samples processed as quickly as possible so acceptance or verification decisions can be made as soon as possible.

Ship or transport acceptance samples to testing laboratories within the timeframes provided in Section 6-102C, “Acceptance Samples and Tests,” of this manual. Assure the proper chain of custody is maintained throughout the process, including delivery to and receipt from a commercial shipping service. Use Form CEM-3701, “Test Result Summary,” to summarize acceptance test frequency and results on each material. Use this form to record the dates samples were taken, shipped to laboratory, test result received from laboratory, and the contractor notified of test results. Monitor timeliness of material testing turnaround against Table 6-1.2., “Time Required for Materials Acceptance Tests,” of this manual and make sure corrective actions are taken and documented if deficiencies are encountered.

Notify the contractor of all acceptance test results within 2 business days of receipt from laboratory, except when using the SPF process. Do not share the verification test results for pay factor quality characteristics until the contractor has completed the lot and submitted the results of pay factor quality characteristic test results in the lot.

Quality pavement is obtained by strictly enforcing the specifications and notifying the contractor of failed tests as soon as possible. When a single quality assurance test for a single quality characteristic indicates that material does not comply, under the standard process, follow guidance in Section 4-3904A (1), “Acceptance Test Results Outside Specified Limits on Non-Statistical Pay Factor Projects,” of this manual. Under the SPF process, for non-pay factor quality characteristics, follow the guidance in Section 4-3904A (5), “Monitoring Non-Pay Factor Quality Characteristics Using Statistical Pay Factor Specifications” of this manual.

For the SPF process, Caltrans samples and tests for verification of pay factor quality characteristics in accordance with stratified random sampling plans developed by the engineer. See Section 4-3902K, “Stratified Random Sampling Plan” of this manual for guidance on developing the sampling plans.

For the SPF process, Caltrans samples and tests non-pay factor quality characteristics at frequencies shown in Section 6-1, “Sample Types and Frequencies.”

For HMA placed using the SPF process, once a lot has been completed and you have received all of the contractor’s test results, immediately share your verification test results with the contractor.

Use Caltrans’ SPFPay spreadsheet to verify the contractor’s quality control test results and determine the applicable payment adjustment. The spreadsheet is available at:

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

Except for pay factor quality characteristics using the SPF process, when 2 consecutive acceptance tests for a single quality characteristic do not comply with the specifications:

- Immediately notify the contractor to stop production.
- Verify that the contractor takes corrective action.

After the corrective action has been taken and the contractor has quality control test results showing conformance, witness the contractor taking and splitting samples into 4 parts for the resident engineer's tests. The contractor must test 1 part for compliance with the specifications and submit 3 parts to the resident engineer, who tests 1 part for compliance with the specifications and stores 2 parts.

4-3903A (3) Dispute Process

The dispute resolution process for acceptance tests for all HMA placed using the standard process is specified in Section 39-2.01A(4)(i)(iv), "Dispute Resolution," of the *Standard Specifications*.

The dispute resolution process for HMA placed using the SPF process is specified in Section 39-2.09A(4)(c)(v)(A), "Dispute Resolution" for Type A HMA and in Section 39-2.10A(4)(c)(v)(A), "Dispute Resolution" for RHMA-G of the project's special provisions. Within each of these specifications, there are different dispute resolution processes for pay factor and non-pay factor quality characteristics.

For pay factor quality characteristics, when the engineer does not verify the contractor's quality control test results, the resident engineer notifies the contractor of the failed verification. The resident engineer uses Caltrans' test results to determine acceptance and the applicable payment adjustment.

If the contractor disputes Caltrans' determination of a non-verification, the specification requires the contractor to formally request dispute resolution. The first step of the dispute resolution process requires that the resident engineer and contractor share each other's tests results, supporting calculations, and together investigate why the difference exists.

If a reason for the difference cannot be found and corrected, and the contractor continues to dispute Caltrans' test results, the resident engineer provides to the independent third party split samples from Caltrans' samples used to produce the test results. The independent results are then compared to the contractor's test results to determine whether the contractor's quality control test results are compliant.

If the independent third-party test results verify the contractor's test results, the contractor's test results are used for acceptance and determination of the applicable adjustment. Caltrans pays for the independent third-party testing costs.

If the independent third-party does not verify the contractor's test results, the independent results are used for acceptance and determination of the payment adjustment, and the contractor pays for the independent testing costs.

For dispute of non-pay factor tests results, refer to Section 4-3904A (5), “Monitoring Non-Pay Factor Quality Characteristics Using Statistical Pay Factor Specifications” of this manual.

A contractor disputing the acceptance test results must notify the resident engineer within 5 business days of receiving a test result. Caltrans may also dispute the contractor’s test results. To resolve disputed test results, the specifications require the use of an independent third party to perform referee testing. If the contractor disputes Caltrans’ acceptance test results, and the resident engineer is satisfied with acceptance test results, before using the independent third party, suggest that the contractor test 1 of the split samples from the material in question. If the contractor agrees to perform this test, it would be good practice to have a tester or a district independent assurance representative witness the contractor’s testing.

The specifications require the testing of split samples of disputed material. If split samples of the material tests being disputed are not available, the third party uses any available material representing the disputed HMA for evaluation. Caltrans must retain possession of the split samples. Caltrans may discard stored split samples 5 days after the contractor has received the associated acceptance test results.

4-3903B Production Start-Up Evaluation

Section 39-2.01A(4)(h)(v), “Production Start-Up Evaluation,” of the *Standard Specifications* applies to all construction processes. The production start-up evaluation allows:

- The contractor to compare quality control test results against Caltrans’ acceptance test results on split sample material.
- Caltrans to verify early in the project that the aggregate properties and HMA comply with the job mix formula and specifications.
- Both parties to examine results of tests performed on split sample material.

Split samples are used only for job mix formula verification, for production start-up evaluation, and when the contractor is demonstrating compliance with the specifications if production has been stopped for out-of-specification material. In all other circumstances, acceptance samples must always be taken independently of contractor’s quality control samples.

4-3903C Plant Operations

Before shift production begins, the plant inspector generally takes the following steps related to HMA plant operations:

- Verifies that the security seal has not been tampered with. If tampering is suspected, contact the district weights and measures coordinator.
- Verifies that the portioning equipment is interlocked as specified in the *MPQP*.
- Makes sure the job mix formula being used by the contractor is specific to 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 or percentage of any component material used in asphalt rubber binder
5. Combined aggregate gradation
6. Aggregate sources
7. Substitution rate for recycled asphalt pavement aggregate of more than 5 percent
8. Any material in the job mix formula

- Notifies the resident engineer if there are changes in the job mix formula and asks if a new job mix formula will be required from the contractor before production can be started.
- Makes certain 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 the Division of Engineering Services Asphalt Supplier Prequalification Program. Notifies the contractor and resident engineer if asphalt binder testing has not been completed for a supplier not on the approved supplier list.
- Makes sure that aggregate is stored separately, according to proposed sizes by comparing the material from each bin with Section 2-2.06, “Aggregate Storage,” of the *MPQP* manual. If any segregation, degradation, or intermingling occurs, require that the contractor empty the storage facility and dispose of or re-screen the material.
- Checks that supplemental fine aggregate remains dry and is stored separately as specified in *MPQP* guidelines.

During production, the plant inspector generally takes the following steps related to HMA plant operations:

- Records daily HMA plant production information on Form CEM-3501, “Hot Mix Asphalt Production Report.”
- Documents on Form CEM-4601, “Assistant Resident Engineer’s Daily Report,” additional information about plant production, including instructions to contractor’s personnel.

The plant inspector performs the following additional duties:

1. Verifies that contractor personnel who sample or witness the contractor sampling at the hot mix asphalt plant are qualified to perform California Test 125, “Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections.”
2. Obtains HMA samples for acceptance testing every 750 tons and tests at least once for every 5 samples or a minimum of once each day. Material

samples must be split into 2 parts, 1 sample for potential acceptance testing and 1 for potential dispute resolution testing.

3. Samples for aggregate gradation at least once for every 750 tons, and tests at least once for every 5 samples or a minimum of once each day. Material samples must be split into 2 parts, 1 sample for potential acceptance testing and 1 for potential dispute resolution testing.
4. Monitors the contractor's HMA plant inspection for compliance with the contractor's quality control plan. Notifies the resident engineer of any noncompliance issues.

4-3903C (1) Antistrip Treatment of Aggregates and Hot Mix Asphalt

The HMA may be sensitive to moisture damage and may require one of the following antistrip treatments:

- Hot mix asphalt aggregate treatment—slurry method
- Hot mix asphalt aggregate treatment—dry lime method
- Liquid antistrip method

4-3903C (1a) Marinated Lime-Treated Aggregate

Aggregate that has been lime treated and stockpiled for marination is handled in the HMA production process in the same manner as untreated aggregates. Refer to Section 4-3902H (1), "Lime Treatment of Aggregates," of this manual for lime treatment plant operation requirements.

For aggregates that have been lime treated and stockpiled:

- Verify that aggregate quality characteristic acceptance samples and tests were performed and the aggregate meets the contract specifications.
- Do not perform sampling and testing for sand equivalent or aggregate quality characteristics as shown in Section 4-3903C (3), "Hot Mix Asphalt Production," of this manual.
- Verify that the lime marination was performed within the past 60 days.

Recycled asphalt pavement used in the production of HMA does not need to be lime treated.

4-3903C (1b) Hot Mix Asphalt Aggregate Treatment—Slurry Method

If an HMA production facility is using this process without marination, contact the Materials Engineering and Testing Services (METS) for assistance.

4-3903C (1c) Hot Mix Asphalt Aggregate Treatment—Dry Lime Method

The quality characteristic acceptance test limits for aggregate properties are based on untreated aggregates. Aggregate testing must be performed on aggregate samples taken before lime treatment.

During lime treatment, the plant inspector takes the following steps:

- Obtains aggregate samples from stockpiles or from the aggregate belts before lime treatment for moisture content and sand equivalent testing at the frequency shown in Table 6-1.13., “Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete,” of this manual. Samples aggregate in accordance with California Test 125, “Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections.”
- Tests aggregate samples for sand equivalent at the frequency shown in Table 6-1.13. of this manual. If the aggregates are not combined before sampling, combines aggregate from individual stockpiles or belts in the job mix formula proportions to test for sand equivalent.
- Tests aggregate samples for moisture content in accordance with AASHTO T 255, “Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying,” or AASHTO T 329, “Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method,” because moisture influences proportioning. For lime slurry aggregate treatment, the plant inspector confirms that the contractor is performing sampling and testing for moisture content at least once every 2 hours of treatment. For lime-treated aggregate, the plant inspector confirms that the contractor is performing sampling and testing for moisture content at a frequency shown under the quality control section applicable to the type of HMA.

  Compares the contractor’s aggregate moisture quality control test results against the Caltrans test results. Notifies both the contractor and the resident engineer if the test results are significantly different.

  Verifies that the contractor is adjusting the HMA plant controller based on the contractor’s aggregate moisture quality control test results.
- Obtains aggregate samples from stockpiles or aggregate belts before lime treatment in accordance with California Test 125. Samples aggregates at the frequency shown in Table 6-1.13. of this manual for aggregate acceptance testing.
- Tests aggregate for acceptance quality characteristics at the frequency shown in Table 6-1.13. of this manual for the following aggregate acceptance tests:
  1. Los Angeles Abrasion Test
  2. Percent of crushed particles coarse aggregate
  3. Percent of crushed particles fine aggregate
  4. Fine aggregate angularity
  5. Flat and elongated particles
  6. Other aggregate properties specified in the project special provisions if applicable

If samples will be shipped to a district materials laboratory or to a construction laboratory, complete Form TL-0101, “Sample Identification Card,” following the instructions in the accompanying booklet and the information in Section 6-103, “Field

Sampled Material Identification for Testing," of this manual. Record the type of mix, the HMA producer, and the producer mix identification number. Check the box on the sample TL-0101 for acceptance test. Ship the samples to the district materials laboratory or field construction laboratory for testing. If any test results exceed the specified limits, the testing laboratory will immediately notify the resident engineer.

Make sure that aggregate treatment is adequate by witnessing contractor quality control testing, and that the contractor enters the treatment data specified in the special provisions into a log. For each day of aggregate lime treatment, obtain the treatment data log electronically for the resident engineer's project file.

4-3903C (1d) Liquid Antistrip Treatment

Make sure that data required in the liquid antistrip treatment section of the special provisions is entered into the production unit's treatment data log and submitted in the required format.

For each day of antistrip treatment, obtain the treatment data log electronically for the resident engineer's project files.

4-3903C (2) Production Start-Up Evaluation

A production start-up evaluation occurs within the first 750 tons produced on the first day of HMA production. The evaluation is also required when production has stopped for more than 30 days and if a new job mix formula is being used.

The plant inspector generally takes the following steps related to a production start-up evaluation:

- During the first 750 tons of production, witnesses the contractor sampling aggregate, asphalt binder, and recycled asphalt pavement on the first day of production in accordance with Section 39-2.01A(4)(h)(v), "Production Start-Up Evaluation," of the *Standard Specifications,* and California Test 125, "Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections." The inspector retains 3 split samples for testing and dispute resolution as described earlier.
- Labels each HMA sample with enough information to identify the exact location. Refer to Section 4-3903C (3), "Hot Mix Asphalt Production," of this manual.
- Ships 1 sample of asphalt binder to METS for testing as detailed in Section 6-2, "Acceptance of Manufactured or Fabricated Materials and Products," of this manual, noting that it is a production start-up acceptance test.
- Immediately tests 1 aggregate sample for aggregate gradation and sand equivalent. If recycled asphalt pavement is used, determine aggregate gradation in accordance with 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)." California Test 384 is available at:

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

- When test results fall outside the specification limits, the inspector notifies the contractor, and requires and confirms that the contractor takes corrective action.
- If aggregate gradation or sand equivalent test results fall outside the specification limits, notify the resident engineer immediately.
- Tests 1 aggregate sample for aggregate acceptance quality characteristics.

  For samples that will be shipped to the district material laboratory or field construction laboratory for testing, complete Form TL-0101, "Sample Identification Card," following the instructions printed in the form booklet and the information in Section 6-103, "Field Sampled Material Identification for Testing," of this manual. Record the type of mix, the HMA producer, the producer's mix identification number, and the production tonnage that this sample represents.

  Check the box on the sample TL-0101 for acceptance test, marked Priority, and include Production Start-Up Evaluation Test under Remarks. Under Remarks, identify the tests to be performed:

  1. Los Angeles Abrasion Test
  2. Percent of crushed particles coarse aggregate
  3. Percent of crushed particles fine aggregate
  4. Fine aggregate angularity
  5. Flat and elongated particles
  6. Other aggregate properties specified in the project special provisions, if applicable

  The specifications require 3 days for test result turnaround, so samples must be shipped immediately. If any tests results fall outside the specified limits, the testing laboratory will immediately notify the resident engineer.

4-3903C (3) Hot Mix Asphalt Production

During production, the plant inspector generally takes the following steps related to HMA plant operations:

- Observes the overall plant operation to make sure the contractor controls dust and smoke. Requests that the contractor corrects any obvious violation and ceases operation if necessary to prevent damage to HMA mixture.
- Obtains aggregate samples and performs AASHTO T 255, "Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying," or AASHTO T 329, "Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method."
- Confirms that the contractor is performing sampling and testing for moisture content at the frequency shown under the quality control section of the *Standard Specifications* applicable to the type of HMA. Because moisture influences proportioning, it is good practice to test both aggregate and recycled asphalt pavement for moisture content.

- Compares the contractor's quality control test results with Caltrans' test results and notifies both the contractor and resident engineer if the test results are significantly different. On SPF projects, the Caltrans verification test results for pay factor quality characteristics are not shared with the contractor until the contractor submits all test results for the lot.
- Verifies that the contractor is adjusting the HMA plant controller based on the contractor's aggregate moisture quality control testing.
- Obtains aggregate samples for field testing for aggregate grading and sand equivalent at the frequency shown in Table 6-1.13., "Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete," of this manual. Tests aggregate samples before lime treatment for testing sand equivalent. Recycled asphalt pavement does not need to be sampled for sand equivalent. Do not use aggregate samplers that do not safely produce a manageable size sample.
- Labels each aggregate sample with the contract number, date, type of mix, aggregate gradation, for example, 1/2-inch, aggregate source, HMA producer, and producer's mix identification number. Indicates the number of tons produced when the sample was taken.
- Tests aggregate samples for aggregate gradation and sand equivalent at the frequency shown in Table 6-1.13. of this manual. If recycled asphalt pavement is used, determine aggregate gradation in accordance with 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)." California Test 384 is available at:

  https://dot.ca.gov/programs/engineering-services/california-test-methods
- Notifies the contractor of aggregate gradation and sand equivalent test results, and confirms that any required plant adjustment has been made to correct for out-of-specification aggregate gradation.
- If aggregate gradation or sand equivalent test results fall outside the specification limits, notifies the resident engineer immediately. If the contractor makes significant or numerous adjustments in bin aggregate proportions, increase the frequency of aggregate gradation testing.
- Obtains aggregate samples for aggregate acceptance quality characteristics at the sampling frequencies shown in Table 6-1.13. of this manual and sample in accordance with California Test 125. If lime-treated, aggregate samples must be taken before lime treatment for testing aggregate properties. Recycled asphalt pavement does not need to be sampled.
- Labels each aggregate sample with the contract number, date, type of mix, aggregate gradation, aggregate source, HMA producer, and producer's mix identification number. Indicates the number of tons produced when the sample was taken. Refers to the guidance in Section 4-3903D (5), "Sampling and Testing Hot Mix Asphalt," of this manual. Tests aggregate at the frequency shown in Table 6-1.13. of this manual. For samples that will be shipped to the district

material laboratory or field construction laboratory for testing, completes Form TL-0101, “Sample Identification Card.” Follows the instructions printed in the booklet that contains the form and the information in Section 6-103, “Field Sampled Material Identification for Testing,” of this manual. Records the type of mix, the HMA producer, and the producer’s mix identification number. Checks the acceptance tests box on the TL-0101. Under “Remarks,” identifies the tests to be performed:

1. Los Angeles Abrasion Test
2. Percent of crushed particles coarse aggregate
3. Percent of crushed particles fine aggregate
4. Fine aggregate angularity
5. Flat and elongated particles
6. Other aggregate properties specified in the project special provisions, if applicable

If any test results exceed the specified limits, the materials laboratory will immediately notify the resident engineer.

If any single quality characteristic has two consecutive acceptance or quality control tests not in compliance with the specifications, verify that before resuming production and placement of HMA on the project, the contractor:

1. Stops production
2. Notifies the resident engineer
3. Takes corrective action
4. Provides a split sample for the engineer’s testing
5. Demonstrates compliance with the specifications before resuming production and placement of HMA on the project

- Samples asphalt binder at the frequencies shown in Section 6-1, “Sample Types and Frequencies,” and in accordance with Section 6-2, “Acceptance of Manufactured or Fabricated Materials and Products,” of this manual, and fills out Form TL-0101 before shipping samples to METS for testing.
- Assures asphalt binder quality by following Section 4-92, “Asphalt Binders,” of this manual.
- For asphalt rubber binder components:
  1. Collects certificates of compliance for each truckload of crumb rubber modifier and asphalt modifier.
  2. Collects a “Buy America” certificate for each truckload of crumb rubber modifier. Refer to Section 3-604, “Buy America,” of this manual for more information.
  3. Samples asphalt modifier binder at the frequencies shown in Section 6-1, “Sample Types and Frequencies,” of this manual. Ships to METS as detailed

in Section 6-2, “Acceptance of Manufactured or Fabricated Materials and Products,” of this manual.

4. Makes sure the contractor submits Form CEM-4410, “Crumb Rubber Usage Report,” monthly and at the end of the project. Refer to Section 7-108, “Crumb Rubber Usage Reporting,” of this manual for more information.

- Verifies that the temperatures of the asphalt binder, aggregate, and HMA do not exceed the limits specified in Section 39-2.01B(8), “Hot Mix Asphalt Production,” of the *Standard Specifications*.
- Makes sure that the batch size and feed rates do not exceed the mixing capacity range used during plant dynamic testing.
- Verifies HMA mix moisture content from samples taken behind the paver in accordance with AASHTO T 329, “Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method.” However, the HMA can be sampled and tested at the plant to determine if sampling and testing at the mat are necessary by performing the following informal test. If HMA samples taken at the plant meet the mix moisture acceptance requirements, samples taken behind the paver will also meet the specification requirement.

  To perform an informal, quick moisture content check at the plant, use the following procedure:

  1. Have the contractor take a shovelful of aggregate from the dryer’s discharge chute
  2. Notice any steaming or dark spots on the aggregate
  3. Pass a cool, shiny, clean mirror, spatula, or similar item in a slow, deliberate motion immediately above the aggregate
  4. Observe the amount of condensed moisture on the item
  5. Advise the contractor if moisture is seen

  This informal method cannot be used for acceptance.
- Observes production to assure the specified HMA mixture conforms to project specifications and the *MPQP*.

4-3903C (3a) Batch Plants

Do not approve a shorter mixing time than was used during the plant dynamic testing conducted for plant acceptance, in accordance with Section 3-2.02, “Dynamic Testing,” of the *MPQP* manual.

Verify that the automatic batching equipment functions within the limits specified in Section 2-2.08, “Batch Mixing Hot Mix Asphalt Plants,” of the *MPQP* manual.

4-3903C (3b) Continuous Mixing Plants

For continuous mixing plants, such as dryer drum or dryer drum pugmill, verify that the following are operating:

1. Vibrating unit on the fine bins
2. Low-level and no-flow interlock systems for aggregate and recycled 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 HMA storage

The mixing time depends on the length of the mixing area and the rate of drop in the dryer drum during mixing. The most efficient pugmill mixing occurs when the material level remains at the top of the paddles along the length of the mixer. For best results, feeding must be continuous and uniform. Do not approve a production rate faster or slower than the range of production used during the plant dynamic testing conducted for plant acceptance in accordance with Section 3-2.02, "Dynamic Testing," of the *MPQP* manual.

4-3903C (4) Plant Weighing Systems

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 weigh box containing the total batch does not come in contact with anything that prevents a true indication of the batch weight.
- When intermediate storage, such as a silo, is used for HMA, periodically check the batching by comparing the total weight of the batches in a truckload with the platform scale weight for the same load.
- 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.

When plants are used for only one project, the accuracy of meter-driven devices that proportion asphalt binder can be checked. To do so, compare meter totalizer readings with asphalt binder tank stabbings and, in conjunction with an on-site vehicle scale, with the combined aggregate totalizer readings. Take into account any wasted mix or individual ingredients wasted after proportioning.

4-3903C (5) Hot Mix Asphalt Storage

Verify that HMA storage silos are in accordance with Section 2-2.11, "Hot Mix Asphalt Storage," of the *MPQP* manual.

4-3903C (6) Hot Mix Asphalt Transporting

Before the trucks are loaded, verify the absence of an excessive amount of parting agent or other contaminating material. Such material is excessive when it forms

pools. Diesel or other petroleum-based products are prohibited from use as parting agents.

After the trucks are loaded, be sure the HMA aggregates are coated with the asphalt binder and not segregated. Notify the resident engineer if loads need to be rejected based on nonuniformity of HMA mixture.

Make sure that rubberized HMA gap-graded and open-graded friction course loads are completely covered with tarpaulins when the atmospheric temperature is below 70 degrees Fahrenheit. Tarps are not required if the time from discharge to truck until transfer to the paver's hopper or to the pavement surface is less than 30 minutes. If the trucks are tarped, record that information on Form CEM-3501, "Hot Mix Asphalt Production Report."

4-3903D Paving Operations

During HMA placement, the paving inspector generally takes the following steps:

- Record daily HMA placement information on Form CEM-3502, "Hot Mix Asphalt Placement Report," and additional information, including instructions to contractor's personnel, on Form CEM-4601, "Assistant Resident Engineer's Daily Report."
- Refer to the *Construction of Quality Asphalt Pavements*, published by the Asphalt Institute, as guidance for best practices during HMA placement.

4-3903D (1) Atmospheric and Pavement Temperature

- Verify that placement occurs within the specified temperature ranges by taking sufficient measurements of the atmosphere, pavement, and HMA. The temperature ranges vary based on the type of HMA being placed. For temperature range requirements, refer to Section 39-2.01C(1) "General," and 39-2.02C, "Construction," of the *Standard Specifications*.
- Record temperatures and the time taken on Form CEM-3502, "Hot Mix Asphalt Placement Report." Notify the contractor to stop HMA placement when temperatures are below specified limits.

4-3903D (2) Tack Coat

- Make sure that tack coat is applied to surfaces to be paved and at a high enough rate to meet the minimum residual rate specified. Use guidance in Section 4-9403, "During the Course of Work," of this manual to determine the minimum required spray rate. The contractor may request and the paving inspector authorize that the application of tack coat is waived between layers when both of the following conditions apply:
  1. The surface to be paved does not have a film of dust or clay
  2. The temperature of the surface to be paved is at least 140 degrees Fahrenheit

- If the contractor uses asphaltic emulsion that has not yet been tested by Caltrans, verify that each delivery of asphaltic emulsion includes a certificate of compliance that covers items described in Section 94-1.01C, “Submittals,” of the *Standard Specifications*. Also, check that each delivery includes a safety data sheet.
- Make sure that if asphaltic emulsion has been diluted, the contractor notifies the engineer of the dilution rate and includes the dilution information required by Section 39-2.01C(3)(f), “Tack Coat,” of the *Standard Specifications*.
- For information on inspecting tack coat, refer to Section 4-3908A, “References,” of this manual for the *Tack Coat Guidelines* website.
- The quantity for payment for tack coat is weight of asphalt binder, or the weight of residual asphalt if asphaltic emulsion is used as a tack coat. The application rate must meet the minimum residual rate specified in the specification.

4-3903D (3) Transporting and Spreading

- Verify that HMA delivery trucks have weighmaster certificates and collect the certificates electronically or from the arriving trucks. If inspection resources are limited, collect weighmaster certificates intermittently throughout the paving shift or daily. If HMA loads are rejected before placement, note on the back of the weighmaster certificate or on the electronic file and on Form CEM-4601, “Assistant Resident Engineer’s Daily Report,” why the HMA was rejected, such as cold mix, segregated mix, or contaminated mix.
- Be aware that queuing of trucks may contribute to excessive cooling of HMA mixture.
- Make sure the contractor uses a material transfer vehicle (MTV) when required. Section 39, “Asphalt Concrete,” of the *Standard Specifications* requires the use of an MTV for all types of HMA except Type A and minor HMA. The special provisions may require the use of MTV for Type A.
- Make sure the contractor does not cross a structure with an MTV or other heavy paving equipment that exceeds the weight limits for a vehicle on highways as defined in California Vehicle Code, Division 15, “Size, Weight, and Load,” without written authorization. Coordinate all requests for authorization with the project’s structure representative. If the project has not been assigned a structure representative, coordinate the review through the bridge construction engineer.
- If windrowing is used, prevent overcooling of the HMA by not allowing excessive windrowing. When “method” compaction is used, verify that the windrow temperature does not fall below 260 degrees, or below 250 degrees Fahrenheit when WMA “additive” technology is used. In all cases, check that the windrow length does not exceed 250 feet in front of the loading equipment.
    1. Windrow temperatures can be monitored with an infrared heat gun. Type A HMA may be rejected for not meeting minimum first coverage of breakdown surface temperature shown in Section 39-2.02C, “Construction,” of the *Standard Specifications*. RHMA-G also may be rejected for not meeting

minimum first coverage of breakdown surface temperature shown in Section 39-2.03C, “Construction,” of the *Standard Specifications*.

2. When using a heat gun on a windrow, be aware that the instrument measures only surface temperature and that the interior of the windrow is hotter. When the HMA is run through the MTV, paver, or both, the mat temperature may be above the minimum specified breakdown temperature.
3. If windrow temperatures are inadequate, or if visual inspection of the material in the windrow identifies segregation, poor mixing, or an over-rich mix, notify the contractor. If this material is incorporated into the paving, additional inspection and testing may be necessary to determine if the mix is acceptable.

- When HMA is placed against the edge of a longitudinal or transverse construction joint that is damaged or not placed in a neat line, make sure the contractor saw cuts or grinds the pavement straight and vertically along the joint and removes the extraneous material.
- Verify that longitudinal joints on the finished surface correspond to the edge of traffic lanes and in lower lifts are offset and alternated at least 0.5 foot from each side of the lane line.
- Assure that the paver spreads the HMA at the required thickness and that lift thickness for Type A complies with Section 39-2.02C “Construction,” of the *Standard Specifications*, and for HMA placed under method compaction specifications, the lift thickness does not exceed 0.25 foot.
- Verify pavement thickness by comparing the HMA spread rate with the theoretical rate and, if necessary, require the contractor to make adjustments.

  Following is an example spread-rate calculation assuming 12 feet wide, 0.15-foot thickness, mix 150 pounds per cubic foot, and 16 tons shown on a weighmaster certificate.

  1. Calculate the weight of HMA 0.15-foot thick required for 1 square foot: 150 x 0.15 = 22.5 pounds per square foot
  2. Calculate the weight of HMA for 1 linear foot:
     22.5 x 12 = 270 pounds per linear foot
  3. Calculate the linear feet that can be covered by one truckload:
     (16 tons x 2,000 pounds per ton) ÷ 270 pounds per linear foot = 118.5 linear feet
  4. Calculate the linear feet covered by 1 ton of HMA: 2,000 pounds per ton ÷ 270 pounds per linear foot = 7.41 feet

  Check layer thickness and spread rate during placement, and check daily theoretical spread rate against the distance actually paved for the day. Note these on Form CEM-3502, “Hot Mix Asphalt Placement Report.”

Payment for HMA is based on the weight shown on the weighmaster certificate. Because of the high cost of HMA, it is important to monitor the spread rate so an excess of HMA is not placed and project funding is not exceeded.

4-3903D (4) Production Start-Up Evaluation Samples

Section 39-2.01A(4)(h)(v), "Production Start-Up Evaluation," of the *Standard Specification*s requires samples of HMA within the first 750 tons of production on the first day of production.

- Observe the contractor sampling from the mat behind the paver or other location approved by the resident engineer. The contractor must sample in accordance with California Test 125, "Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections," and give the resident engineer 3 of the 4 split samples.
- Test the HMA production start-up evaluation sample for quality characteristics shown in Section 4-3903D (5), "Sampling and Testing Hot Mix Asphalt," of this manual.
- Test aggregate at the frequency shown in Table 6-1.13., "Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete," of this manual. For samples that will be shipped to the district material laboratory or field construction laboratory for testing, complete Form TL-0101, "Sample Identification Card." Follow the instructions printed in the form booklet and the information in Section 6-103, "Field Sampled Material Identification for Testing," of this manual. Record the type of mix, the HMA producer, and the producer's mix identification number. Check the acceptance tests box on the TL-0101. Under Remarks, identify the tests to be performed.

  Label each HMA sample with enough information to identify the exact location. Refer to the description in Section 4-3903D (5) of this manual.

Check the box on TL-0101 for acceptance test marked Priority, and include Production Start-up Evaluation Test under Remarks. Also under Remarks, list all required acceptance tests. The resident engineer must report the test results to the contractor within 5 business days of sampling. For AASHTO T 324 (Modified), "Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures," and AASHTO T 283, "Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage," test results, report test results within 15 days of sampling. To meet these timelines, ship samples immediately.

4-3903D (5) Sampling and Testing Hot Mix Asphalt

- Obtain split samples of HMA from the mat behind the paver or other location approved by the resident engineer, in accordance with California Test 125, "Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections." Table 6-1.13., "Materials Acceptance

Sampling and Testing Requirements: Asphalt Concrete," of this manual provides the frequency for sampling HMA mix.

Label each HMA sample with the aggregate grading, for example, 1/2-inch, asphalt binder target value, producer, and producer's mix identification number. Indicate both the stationing where the sample was taken and the area represented; for example, STA 100+50, NB, Lane 1, first layer. Also include the Form TL-0101, "Sample Identification Card," number if the sample is being shipped to the district material laboratory or field construction laboratory for testing. The label must have enough information to identify the exact location in the event the HMA is rejected and must be removed.

- Test aggregate at the frequency shown in Table 6-1.13. of this manual. For samples that will be shipped to the district material laboratory or field construction laboratory for testing, complete Form TL-0101. Follow the instructions printed in the form booklet and the information in Section 6-103, "Field Sampled Material Identification for Testing," of this manual. Record the type of mix, the HMA producer, and the producer's mix identification number. Check the acceptance tests box on the TL-0101, and identify the acceptance tests to be performed under Remarks. Include only the acceptance tests that you are requesting to meet the acceptance test frequency in Table 6-1.13. of this manual:
  - Asphalt binder content
  - Air voids content at N-design
  - Voids in mineral aggregate
  - Dust proportion, report only if an adjustment for asphalt binder content target value is less than 0.3 percent from optimum binder content
  - Maximum theoretical density, AASHTO T 209, Method A, "Standard Method of Test for Theoretical Maximum Specific Gravity (G mm) and Density of Asphalt Mixtures
  - Hamburg Wheel Track, AASHTO T 324 (Modified)
  - Moisture susceptibility, AASHTO T 283, both dry strength and wet strength

  If any single quality characteristic, except smoothness, has 2 consecutive acceptance or quality control tests out of compliance with the specifications, or any 3 quality characteristics of quality control tests or acceptance tests for 1 day production are out of compliance with the specifications, verify that before resuming production and placement of HMA on the project, the contractor:

  1. Stops production
  2. Notifies the resident engineer
  3. Takes corrective action
  4. Provides a split sample for the engineer's testing
  5. Demonstrates compliance with the specifications

4-3903D (6) Compaction

The contractor must comply with the method process in Section 39-2.01C(2)(c), "Method Compaction Equipment," and in Section 39-2.01C(15)(b), "Method Compaction," of the *Standard Specifications* if:

- The total paved thickness is less than 0.15 foot
- The HMA is used in:
  - Asphalt concrete remove-and-replace areas, or dig outs
  - Leveling courses
  - Detours not to remain in the final roadway structural section
  - Areas in which the resident engineer determines that conventional compaction and compaction measurement methods are impeded

4-3903D (6a) Method Process Compaction

For the method process HMA compaction:

- Use the MultiCool program as a guide for determining the length of time available for achieving compaction, based on layer thickness, HMA temperature, existing pavement temperature, and atmospheric temperature. Recognize that the MultiCool program forecasts the average temperature of the HMA lift as a function of time after placement, not the surface temperatures included in the method compaction specifications. The MultiCool program is available at:

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

- Make sure that:
  1. Specified equipment performs the compaction in the specified order.
  2. A required number of coverages is made for each compaction type: first coverage, breakdown, and finish.
  3. The HMA compaction is completed when temperatures are higher than the specified minimum temperature for first coverage, breakdown, and finish.
  4. When a vibratory roller is specified for compaction, the speed of the vibratory roller in miles per hour does not exceed the vibrations per minute divided by 1,000. When the HMA layer thickness is less than 0.08 foot, the vibratory roller must be in the off mode.
  5. When a pneumatic-tire roller is specified for compaction, the speed does not exceed 5 miles per hour.
- Inspect the finished HMA surface for marks, tearing, and irregular texture that may be caused by segregated mix. Notify the contractor of noncompliant areas.

4-3903D (6b) Compaction Determination by Cores

When the total paved thickness is at least 0.15 foot:

- The contractor will determine the number of rollers and sequence necessary to meet the compaction requirements of the specifications.
- For quality control testing, the contractor must use nuclear gauges calibrated to cores under California Test 375, “Determining the In-Place Density and Relative Compaction of Hot Mix Asphalt Pavement Using Nuclear Gages,” to determine the relative compaction.
- The contractor will obtain the cores for the resident engineer within 5 days of HMA placement. The resident engineer will use the cores to determine relative compaction.
    1. Randomly select core locations for every 250 tons of hot mix asphalt placed according to Part 3, Section 3B, “Test Site Location,” of California Test 375, “Determining the In-Place Density and Relative Compaction of Hot Mix Asphalt Pavement Using Nuclear Gages.”
    2. Witness the contractor taking the cores, mark each core, and place the cores in a protective container before taking possession of the cores.
    3. Complete Form TL-0101, “Sample Identification Card,’’ following the instructions printed in the form’s booklet and the information in Section 6-103, “Field Sampled Material Identification for Testing,” of this manual. Identify the stationing from which samples were taken and the area they represent, for example, “lane #1, first layer.” Label the samples with enough information that the exact location HMA was placed can be identified if it is rejected and has to be removed. On Form TL-0101, check the box for acceptance test.
    4. Transport the cores to the district materials laboratory or Construction field laboratory where they will be tested for in-place density (California Test 375), except the density of each core will be determined using AASHTO T 275, Method A, “Standard Method of Test for Bulk Specific Gravity of Compacted Asphalt Mixtures Using Paraffin-Coated Specimens,” and the theoretical maximum density of the mix will be determined using AASHTO T 209, Method A, “Standard Method of Test for Theoretical Maximum Specific Gravity (G mm) and Density of Asphalt Mixtures.”

4-3903D (7) Smoothness

Except for areas that must be tested for smoothness using a 12-foot straightedge, make sure the contractor tests all finish surfaces of HMA and the finish surfaces of the open-graded friction course (OGFC) is being placed on, with an inertial profiler.

The contractor notifies the engineer 10 days before collecting inertial profiler data and schedules smoothness testing with the engineer. Make sure all smoothness testing is performed in the presence of the engineer.

The contractor measures smoothness of new pavement alignment or pavement realignment with an inertial profiler. Caltrans determines smoothness pay adjustments using the table in Section 39-2.01A(4)(i)(iii)(B), “Pay Adjustments for New Pavement Alignment or Pavement Realignment,” of the *Standard Specifications*.

The contractor measures smoothness of pavement constructed on existing pavement surfaces with an inertial profiler. Caltrans determines pay adjustments as shown in the table in Section 39-2.01A(4)(i)(iii)(C), “Pay Adjustments for Pavement Constructed on Existing Pavement Surfaces,” of the *Standard Specifications*.

For asphalt concrete pavement, smoothness measurements are required from the contractor as follows:

1. The contractor must run the inertial profile of the existing asphalt concrete surface before performing any work on the surface, and submit the result labeled as the EXIST inertial profiler data file. Notify the engineer if mean roughness index (MRI) results vary more than 10 percent from the MRI information provided by Caltrans at the time of advertisement. For projects suspended longer than 30 days, measure the smoothness of the existing surface that has not received an HMA overlay and submit the result labeled EXISTR as the inertial profiler data file.
2. If structural repairs, such as remove and replace asphalt concrete or leveling courses, are made on the existing asphalt concrete surfaces, the contractor must run inertial profile and submit the result labeled BASELINE as the inertial profiler data file.
3. The contractor must measure with an inertial profiler the smoothness on pavement segments, exclusive of OGFC on new HMA, before performing any HMA smoothness corrections, and submit the result labeled PAVE as the inertial profiler data file.
4. The contractor must measure with an inertial profiler the smoothness on pavement segments, exclusive of OGFC on new HMA, after performing any HMA smoothness corrective work, and submit the results labeled as FINAL inertial profiler data file. If no corrective work is needed, the PAVE inertial profiler data is used as the FINAL inertial profiler data.
5. Make sure the contractor measures smoothness on all pavement surfaces of OGFC with an inertial profiler before performing any OGFC smoothness correction and submits the result labeled PAVEO as the inertial profiler data file.
6. Make sure the contractor measures all pavement surfaces of OGFC after performing any OGFC smoothness corrective work and submits the result labeled FINALO as the inertial profiler data file. Use the PAVEO inertial profiler data file as the FINALO inertial profiler data file when no corrective work in the segment is performed.

MRI_0 is the lower MRI value from the EXIST and BASELINE profiles for the 0.1-mile segment.

The resident engineer has 2 days after receipt of the data to complete inertial profile verification testing of all data except the *FINAL* inertial profiler data.

The resident engineer has 10 days after receipt of the data to complete verification testing of FINAL inertial profiler data, and the accepted inertial profiler data is used for acceptance and determination of the payment adjustment.

Segments may be correctively ground to improve pay adjustments to full pay. Caltrans does not allow corrective grinding into positive pay adjustments. Caltrans determines positive pay adjustment segments before any corrective grinding occurs. Correction of areas of localized roughness in positive pay adjustment segments cannot improve pay.

Corrective actions may be diamond grinding or remove and replace and must comply with Section 39-2.01C (16), "Smoothness Corrections," of the *Standard Specifications*.

When OGFC is placed over HMA, corrective actions apply to the HMA surface on which the OGFC is placed. Smoothness requirements for OGFC are specified in section 39-2.04A(4)(c)(iii), "Pavement Smoothness of OGFC," of the *Standard Specifications*.

Refer to Section 36-3.01D(3)(b) "Smoothness Measurement," of the *Standard Specifications* for surfaces that are to be measured with a 12-foot straightedge.

If existing asphalt concrete has been cold planed, before overlaying the surface with HMA, make sure the cold planed surface meets the 12-foot straightedge tolerance required by Section 39-3.04C(2) "Grade Control and Surface Smoothness," of the *Standard Specifications*.

The contractor must measure the smoothness of existing pavement segments if structural repairs, such as remove and replace asphalt concrete or leveling courses, are made and submit the result labeled as BASELINE inertial profiler data file.

If a bid item for segment correction of 0.1-mile sections is shown on the bid item list, the contractor must submit the correction plan within 5 days and before making segment corrections. Include the maximum removal depth according to the ProVAL smoothness assurance analysis grinding report or other 3D modeling software report. Make sure the contractor does not remove more than 15 percent of the existing pavement thickness.

Correction includes one or a combination of the following:

- Diamond grinding in the wheel paths, the entire surface, or cold planer or smoothness referencing locations
- Micro-milling in the wheel paths, the entire surface, or cold planer or paver smoothness referencing locations
- 3D modeling of the existing roadway and subsequent automatic machine guidance of either cold planer, paver, or both
- Alternative method of correction authorized by the engineer that complies with final HMA pavement smoothness requirements

Make sure the contractor does not start correcting the existing roadway before the authorization of the correction plan.

Segment correction is considered an opportunity for improvement.

If notified by the contractor that an existing asphalt concrete surface cannot be corrected by prepaving grinding, respond within 5 business days with agreement or disagreement. Formulate the response based on field review of the defined locations and the inertial profile data.

If in agreement that the contractor-defined areas cannot be corrected by grinding, make sure the response defines the lane, direction, and the profiler stationing limits where the 12-foot straightedge will be used to evaluate smoothness on the final HMA surface. Upon completion of the final HMA surface, use these stations to define leave-out sections in the profile data file covering the final HMA surface.

If determined that the contractor-defined areas can be corrected by prepaving grinding, assure that the response defines the reasoning. The reasoning should include a ProVAL grind plan that demonstrates grinding can be performed to meet the requirements in Section 39-2.01C(3)(e), "Prepaving Corrections," of the *Standard Specifications*.

If the project has inadequate funds to cover prepaving grinding, contact the project manager to determine if additional funds are available to cover the additional work.

Where testing with a 12-foot straightedge is required, the paving inspector checks pavement smoothness for acceptance 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*. These checks are in addition to checks the contractor is required to make and report in accordance with Section 36-3.01C(4) "Straightedge Measurements" of the *Standard Specifications.*

The paving inspector records straightedge measurements on Form CEM-4601, "Assistant Resident Engineer's Daily Report," and notifies the contractor of all out-of-specification areas.

Where smoothness is to be measured with an inertial profiler, the contractor must measure smoothness with an inertial profiler that meets the requirements of Section 36-3, "Pavement Smoothness," of the *Standard Specifications.* Follow the guidelines in Section 4-36, "Surfacing and Pavements—General," of this manual to assure that the inertial profiler, inertial profiler operator, submittals, and measurements meet the requirements of Section 36-3, "Pavement Smoothness," of the *Standard Specifications.*

Review Section 39, "Asphalt Concrete," of the *Standard Specifications* for the specified smoothness acceptance requirements. Analyze the contractor's inertial profiles using ProVAL software.

- Check that prepaving grinding is performed only on existing asphalt concrete surfaces. Do not allow prepaving grinding work on existing asphalt concrete surfaces that are designated to be cold planed for mill and fill type paving, or in areas where existing asphalt concrete is designated to be replaced, or has been replaced, such as dig outs. Corrective grinding work on replaced asphalt concrete surfacing is considered part of the replace asphalt concrete surfacing work and is not prepaving grinding work. Make sure the contractor's prepaving

inertial profiles are used to determine where prepaving grinding work is required. Do not use profiles provided with the bid documents.

- Monitor the contractor's planning for prepaving grinding. Document any concerns you have about methods planned for achieving smoothness on an existing surface. A handbook and training videos on using ProVAL to develop grind plans are available at:

  https://dot.ca.gov/programs/construction/training

- After making prepaving grinding corrections, make sure the contractor takes and submits the corresponding inertial profiles. Require the contractor to repeat the prepaving grinding and inertial profile submittal process, if necessary.
- Verify that the profile data file covering the surface of the completed prepaving grinding work defines lane sections where the final pavement surface will and will not have the smoothness specifications applied to it.
- Unless authorized by a change order, reject any HMA placed over an existing asphalt concrete surface that is required to, but does not meet the prepaving grinding smoothness requirements.
- Make sure prepaving inertial profiles are taken before cold planing, and after replacing asphalt concrete surfacing labeled as *BASELINE* inertial profile data.
- Once it has been determined that the contractor's prepaving grinding profiles meet the requirements, request that Caltrans' inertial profiler be run to verify that the profiles are within 10 percent.

Verify that the final HMA surface meets the smoothness requirements.

When OGFC is being placed atop HMA, make sure the HMA surface is free of mandatory correction and meets the ALR smoothness requirements before placement of the OGFC. The contractor must measure pavement segments, exclusive of OGFC on new HMA, with an inertial profiler after performing any HMA smoothness corrective work and submit the results labeled as FINAL inertial profiler data file. If there is no corrective work, the PAVE inertial profiler data is used as the FINAL inertial profiler data.

4-3903D (8) Miscellaneous Areas and Dikes

The contractor must place HMA at miscellaneous areas and dikes where shown on the plans and in accordance with Section 39-2.01B(11), "Miscellaneous Areas and Dikes," of the *Standard Specifications.*

4-3903D (9) Fog Seal Coat

The contractor applies fog seal coat to rumble strip ground areas and ground areas caused by smoothness correction grinding. If smoothness correction grinding is excessive, contact the Division of Maintenance Office of Asphalt Pavements before allowing the contractor to fog seal within the traveled way.

The contract item for fog seal coat is used when fog seal must be applied to shoulders, miscellaneous areas, and dikes. Prohibit the contractor from applying fog seal coat to the traveled way.

Fog seal coat applied to ground-in rumble strips and smoothness correction areas is not paid separately. Refer to Section 4-37, “Seal Coats,” of this manual for additional information.

4-3903D (10) Open to Traffic

Do not allow traffic on new HMA until its mid-depth temperature is below 160 degrees Fahrenheit. The contractor may request in writing and the resident engineer authorize cooling of HMA Type A with water when rolling is complete.

The contractor must spread sand at a rate of 1 to 2 pounds per square yard before opening to public traffic on new rubberized HMA.

Temporary construction signs and temporary pavement delineation must be in place before opening to public traffic.

4-3903D (11) Temporary Transverse Joint Taper

Make sure the contractor constructs a temporary joint taper between the existing pavement and any newly placed paving or cold planing area when a transverse joint greater than 0.04 foot cannot be avoided before opening to traffic.

Verify that the taper transition rates meet the requirements of Section 7-1.03, “Public Convenience,” of the *Standard Specifications.*

Check that the temporary joint taper surface is uniform and there is no more than a 0.02-foot gap from the lower edge of a 12-foot straightedge and the taper surface when placed parallel and perpendicular to traffic.

4-3903D (12) Existing Asphalt Concrete

Make sure the contractor makes a 2-inch deep saw cut along limits where asphalt is designated to be removed.

Check that the contractor schedules cold planing and placement of HMA in accordance with the timeline requirements covered by Section 39-3.04, “Cold Planing Asphalt Concrete Pavement,” of the *Standard Specifications.*

Verify that cold planing equipment has automatic controls for the longitudinal grade and transverse slope of the cutter head. When cold planing, document contractor’s methods to control grades of the cold planer.

Inspect the cold planed surface to verify that the planing operations result in a neat and uniform surface. Make sure the contractor replaces broken, missing, or worn teeth if the surface pattern indicates the surface is not uniform.

Inspect the cold planed surface for signs of delamination. To minimize the potential for differential compaction, if necessary, provide direction to make minor adjustments or second passes to the cold planer to decrease potential for delamination. Document any locations that may cause smoothness issues if left

unaddressed. Document any locations where you and the contractor disagree that delamination may be significant enough to cause differential compaction. Documentation should include high-resolution digital photographs or videos.

4-3904 Contract Administration

The resident engineer must review the notice of materials to be used, review and accept the job mix formula for HMA, review and accept the contractor's quality control plan when applicable, and verify Caltrans inspection reports and acceptance testing results for contract compliance. The resident engineer makes decisions regarding noncompliant materials and placement.

The Federal Highway Administration requires Caltrans to have a quality assurance program. As part of that program, this chapter defines quality assurance and contract administration requirements for HMA. Caltrans requires that these same quality assurance standards be met for state-funded projects. If the requirements are not met, there is a risk that federal funds will be withheld or withdrawn. The resident engineer takes the following steps for HMA contract administration:

- Verifying that Form CEM-3101, "Notice of Materials To Be Used," includes all component materials and materials sources used in HMA. Refer to Section 6-202, "Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products," of this manual for details.
- Making sure that the job mix formula for the project is verified and accepted before placement of HMA.
- Verifying that the contractor's quality control plan is submitted and complies with the requirements of Section 39-2.01A(3)(c) "Quality Control Plan," of the *Standard Specifications.* The quality control plan must describe the organization and procedures used by the contractor to control HMA quality, sampling, implementing and maintaining quality, when corrective actions are needed based on the contractor's action limit, implementing corrective actions, and method used to backfill core locations.

  The submitted quality control plan must also address elements affecting HMA quality: aggregate, asphalt binder, additives, and production paving.

4-3904A Acceptance Testing and Evaluation

The resident engineer makes sure that acceptance testing is performed at least at the minimum frequency shown in Table 6-1.13., "Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete," of this manual. Record test results on Form CEM-3701, "Test Result Summary," so that minimum acceptance testing frequency is documented and easily verified.

The resident engineer verifies that acceptance samples are transported to testing laboratories within the timeframes specified in Example 6-1.2., "Sample Cylinder Label (Set of two 6- by 12-inch cylinders)," of this manual, except where specific sampling or test method requirements preclude doing so, for example, curing of specimens before transport. Test within 1 business day from sampling for projects

within 50 miles of the testing laboratory or within 2 business days from sampling for projects more than 50 miles from the testing laboratory. Make sure chain of custody is maintained throughout the process, including delivery to and receipt from a commercial shipping service. Use Form CEM-3701, "Test Result Summary," to summarize acceptance test frequency and results on each material. Use this form to record dates for sampling, shipping to laboratory, receiving test results from laboratory, and notifying the contractor of test results. Monitor timeliness of material testing turnaround against Table 6-1.2., "Time Required for Materials Acceptance Tests," of this manual, and make sure corrective actions are taken, and document deficiencies encountered. Notify the contractor of all acceptance test results within 2 business days of receipt from laboratory. Make sure to input material sample and test data into DIME for the following 5 HMA and RHMA test methods as of Jan. 1, 2023.

1. AASHTO T 308 and AASHTO T 30, "Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates"
2. AASHTO T 308 Method A, "Method of Test for Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method"
3. AASHTO T 269, "Standard Method of Test for Percent Air Voids in Compacted Dense and Open Asphalt Mixtures"
4. AASHTO T 275 Method A, "Method of Test for Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Paraffin-Coated Specimens"
5. AASHTO T 209 Method A, "Method of Test for Theoretical Maximum Specific Gravity (G mm) and Density of Asphalt Mixtures"

Also advise the contractor that these HMA and RHMA test methods results are in DIME and that all test results are available for inspection. Provide copies of these test results upon request. Maintain copies of the test results in Category 37, "Initial Tests and Acceptance Tests," of the project files.

The resident engineer verifies that final inertial profile submittals meet the requirements for mean roughness index and areas of localized roughness. Use 4-3603B, "Pavement Smoothness," of this manual as a guide in reviewing submittals.

The resident engineer compares the contractor's and Caltrans' International Roughness Index values over each 0.1-mile section of lane. The resident engineer uses the contractor's final inertial profiles for acceptance when they are within 10 percent of Caltrans' values.

The resident engineer assures that production start-up evaluation testing is completed and recorded on Form CEM-3703, "Production Start-Up Evaluation," and that the contractor is provided with a copy of the completed form.

4-3904A (1) Acceptance Test Results Outside Specified Limits on Non-Statistical Pay Factor Projects

If any acceptance test result, except smoothness, is outside the limits specified, notify the contractor in writing that the material represented by the tests is

noncompliant, and include a statement that the noncompliant material is rejected and must be removed or remedied in accordance with Section 5-1.30, "Noncompliant and Unauthorized Work," of the *Standard Specifications*. Attach a copy of the acceptance test result.

Ask the contractor if any corrective action has been taken based on quality control test data for the period when the acceptance sample was taken.

For every in-place density test failure, notify the contractor in writing that the material represented by the failed in-place density test is noncompliant, and include the following statements:

> "The noncompliant material is rejected and must be removed or remedied in accordance with Section 5-1.30, 'Noncompliant and Unauthorized Work,' of the *Standard Specifications.*
>
> "At the engineer's option, noncompliant material may be accepted based on the engineer's evaluation of the effectiveness of your corrective actions. If the engineer decides to accept the noncompliant material, payment will be based on the table 'Reduced Payment Factors for Percent of Maximum Theoretical Density,' in Section 39-2.01A(4)(i)(ii), 'In-Place Density,' of the *Standard Specifications*."

For 2 consecutive density test failures, follow guidance in Section 4-3904A (2) "Two Consecutive Acceptance Test Results Outside of Specification Limits on Non-Statistical Pay Factor Projects," of this manual.

If acceptance test results are disputed within the period specified in Section 39-2.01A(4)(i)(iv), "Dispute Resolution," of the *Standard Specifications,* try to resolve these issues at the project level before involving an independent third party.

If an acceptance test is outside the acceptance specification limits, immediately direct the field Construction lab, district materials lab, or METS to test the most recent acceptance sample for compliance with the specifications. There may be additional samples that have not been tested. Always test the most recently pulled sample first. Designate this sample for priority testing.

If the most recent sample fails, follow guidance in Section 4-3904A (2) of this manual.

If the most recent sample passes, test the samples immediately before and after the initial failed sample. At a minimum, continue testing samples taken before and after the initial failed sample until a sample passes. If during this testing there are 2 consecutive failures on the same quality characteristics, but there are passing results after these failures that indicate necessary corrective actions were already implemented, do not follow the guidance in Section 4-3904A (2) of this manual.

4-3904A (2) Two Consecutive Acceptance Test Results of the Same Quality Characteristics Outside Specification Limits on Non-Statistical Pay Factor Projects

If 2 consecutive acceptance test results for the same quality characteristics do not comply with the specifications:

- Immediately inform the contractor to stop production.
- Inform the contractor in writing that the material represented by the 2 out-of-specification acceptance tests is noncompliant, and include a statement that the noncompliant material is rejected and must be removed or remedied in accordance with Section 5-1.30, "Noncompliant and Unauthorized Work," of the *Standard Specifications*. Attach copies of both test results that indicate the material is outside specification limits.
- Submit any samples taken between the 2 failed tests to the appropriate lab for priority testing to define the amount of material not in compliance with the specifications.
    - Notify the appropriate lab that 2 consecutive acceptance tests are outside the acceptance specification limits.
    - Direct the testing labs to test all samples between the first and second out-of-specification acceptance tests and any remaining samples immediately before or after any failure. Use their test results to define the quantity of hot mix asphalt that will be rejected.
- Notify the contractor in writing of results of all additional acceptance tests conducted to determine the extent of the out-of-specification material. In the notice, include language that the material represented by out-of-specification material is noncompliant and rejected and must be removed or remedied to comply with Section 5-1.30, "Noncompliant and Unauthorized Work," of the *Standard Specifications*.
- Require the contractor to do all of the following:
    1. Take corrective action to remedy the cause of out-of-specification material.
    2. Provide written documentation of corrective action taken.
    3. Demonstrate compliance by providing quality control testing of material produced but not delivered to the project.
    4. Provide samples of HMA for both the resident engineer and contractor to test. The contractor samples this material in the engineer's presence and splits the samples into 4 parts.
    5. Test 1 part of the split sample to verify that the corrective action taken by the contractor was successful.

If both Caltrans' and the contractor's test results are within specifications, the contractor has demonstrated compliance with the specifications and may resume production.

Since the samples tested by the contractor and resident engineer are from a split sample, the test results should not be significantly different. If there is a significant difference, the resident engineer and the contractor should investigate the reason for the discrepancy. Contractors can choose to begin production during this investigation but proceed at their own risk.

- The contractor may dispute any out-of-specification acceptance test result within the specified number of days of receiving the test result by notifying the resident engineer in writing in accordance with Section 39-2.01A(4)(i)(iv), "Dispute Resolution," of the *Standard Specifications*. Try to resolve testing or sampling issues at the project level before involving the independent third party.

4-3904A (3) Contractor Requests for Accepting Noncompliant Work

If the contractor agrees that the HMA placed is noncompliant, the contractor may propose to the resident engineer in writing that the noncompliant material will be remedied or that the noncompliant material will be left in place for reduced compensation. Consult with the district materials engineer and either the Division of Maintenance Office of Asphalt Pavements, the district's Construction field coordinator, or both, about acceptance of the contractor's proposal. Document material remediation or reduced pay by issuing a contractor-requested change order. Document all noncompliant materials test results including the action taken on Form CEM-6302, "Final Materials Certification." Refer to Section 6-106, "Project Materials Certification," of this manual for documentation requirements.

4-3904A (4) Acceptance of Lots Using Statistical Pay Factor Specifications

For an overview of the quality assurance process used for HMA using statistical pay factor specifications, refer to section 4-3901D (2), "Statistical Pay Factor Quality Assurance Process," of this manual.

Administering statistical pay factor (SPF) projects requires analysis of contractor quality control test data, engineer's verification test data, and when a dispute arises, independent third-party laboratory test data. The analysis is performed each day and upon completion of each lot using a Caltrans-furnished spreadsheet to calculate SPFPay. The spreadsheet is available at:

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

The SPF specifications require that the quality control manager enter the quality control test data into the SPFPay spreadsheet after each sublot. The quality control manager submits this data daily to the resident engineer. The resident engineer imports the contractor's quality control data into a copy of the spreadsheet. Any new or revised data is highlighted. If a highlighted test result indicates a previously submitted test result has been changed, the engineer does not accept the data until the contractor provides evidence of justifiable reason for changing the data, such as correcting a clerical error. If the highlighted data is only new test data, the engineer accepts the data.

After accepting the data, the engineer reviews the SPFPay spreadsheet for any stop-production notifications. These stop-production notifications indicate the material in the lot to that point is not acceptable until one or more sublots of material is rejected from the sublot, regardless of improvement to the percent within limits (PWL) or quality factors after the notification. If the resident engineer finds these stop notifications and that the quality control manager did not stop production or notify the engineer of the need to stop production, the resident engineer stops production, and does not allow production to proceed until the contractor identifies the sublot or sublots of material that will be rejected from the lot. The stop notification indicates that PWL for a pay factor quality characteristic fell below an acceptable threshold. The threshold requires the quality factor to be 0.90 or greater, which is also expressed as a PWL of 70 percent or greater. The number 8 sieve is less critical, and requires the quality factor to remain above 0.75, which is also expressed as PWL threshold of 45 percent.

Upon completion of a lot, all stop notifications on previously completed sublots must be cleared. Clearing the stop notifications requires rejection and removal of the sublot, and its corresponding test results from SPFPay. The engineer allows the contractor to continue production of a lot only after the contractor identifies which sublots will be removed and rejected from the lot.

The engineer does not share pay factor verification test data with the contractor until the lot is completed and all of the contractor's quality control test data has been submitted.

At completion of the lot, and within 7 days of receiving all of the quality control test data for the lot, the engineer runs a verification check of the contractor's quality control data and provides the results of the verification check to the contractor. The engineer uses the Priority designation on the verification samples described in section 6-102C, "Acceptance Samples and Tests," of this manual when needed to complete the verification check within the 7-day time period. Once verified, the engineer notifies the contractor and makes the applicable adjustment on the next progress pay estimate.

A lot is a quantity of HMA. A new lot begins when one of the following occurs:

- 20 sublots are complete
- JMF changes
- Production stops for more than 30 days

Upon completion of each lot, the engineer verifies the contractor's quality control data using the engineer's verification test results. The engineer uses the SPFPay spreadsheet to perform this check.

Once the contractor's quality control test data is verified, the engineer accepts the lot. The SPFPay spreadsheet calculates the quality factors for each of the 5 pay factor quality characteristics using the following equation and without rounding:

$$\text{quality factor} = (\text{PWL} \div 2) + 0.55$$

Each quality factor typically results in a value from 0.90 through 1.05. The lot is acceptable when all quality factors are 0.90 or higher, except above 0.75 or higher for the percentage passing the number 8 sieve, and there are no stop notifications shown on any sublot requiring one or more sublots of material to be rejected and removed from the lot.

Once the lot is accepted, the resident engineer pays for the HMA at item price and includes the incentive or disincentive payment adjustment for the lot on the next progress estimate. Refer to Section 4-3907E, "Compensation Adjustment for Hot Mix Asphalt Placed Using the Statistical Pay Factor Specifications," of this manual for guidance on making the payment adjustment.

4-3904A (5) Monitoring Non-Pay Factor Quality Characteristics Using Statistical Pay Factor Specifications

The contractor's minimum sampling frequency is defined in the specifications. When the contractor's testing indicates that a non-pay factor test is out of specification, the contractor is required to notify the engineer and document corrective actions taken. If the contractor's quality control test for a single non-pay factor quality characteristic falls out of specification two consecutive times, or any non-pay factor quality characteristic fails 3 times in a single day, the contractor must stop production, notify the engineer, and demonstrate compliance before continuing production.

The resident engineer may perform testing on non-pay factor quality characteristics at any time, but at a minimum frequency defined in Table 6-1.12., "Materials Acceptance Sampling and Testing Requirements: Seal Coats," of this manual.

When the resident engineer determines that a non-pay factor quality characteristic is to be tested, samples are pulled from 2 consecutive contractor defined sublots. These samples are independent of the contractor's. Refer to Section 4-3903A (2), "Department Acceptance," of this manual for detailed guidance on sampling and testing of non-pay factor quality characteristics, and stopping production because of 2 consecutive non-pay factor test failures.

4-3904B Testing for Significant Difference

The resident engineer should compare the contractor's test results against Caltrans' test results to determine if they are significantly different. Compare the test results in 1 of 2 ways:

1. A 1-to-1 comparison of the test results of a single split sample: job mix formula verification and production start-up.
2. The comparison of groups of test results; that is, the average of all acceptance tests compared to the average of all quality control tests.

The resident engineer should always examine the differences between contractor and Caltrans test results for job mix formula verification, production start-up, and dispute resolution based on a 1-to-1 comparison of the test results. For job mix formula verification and production start-up evaluation, the test result comparison will show whether the contractor and Caltrans can test properly sampled and split

samples for aggregate and HMA and get reasonably close test results. If a significant difference exists, the resident engineer should notify the contractor. The resident engineer and contractor should examine what is causing the difference and try to find a way to bring their results closer.

The resident engineer should never consider a 1-to-1 comparison of 2 test results from different samples, such as Caltrans' acceptance result of a sample taken in the morning compared to a contractor's quality control test result of a sample taken in the afternoon. If examination of the contractor's and Caltrans' test results shows large differences, compare the test result groups to determine if the results are significantly different. Compare the average of all acceptance test results to the average of the contractor's quality control test results, and use Table 4-39.1, "Precision Index," of this manual, to determine if the difference between the test results is reasonable or significantly different. If the comparison between the test results indicates a significant difference, notify the contractor. The resident engineer and contractor together should examine and investigate the cause of test result differences.

Use the reasonable testing difference values in Table 4-39.1. to evaluate whether a significant testing difference exists.

Table 4-39.1. Precision Index

Quality Characteristic	Test Method	Reasonable Testing Differences Single Results	Reasonable Testing Differences Averages
Sand equivalent	AASHTO T 176	6	2
Theoretical maximum specific gravity (see Note 1)	CT 375	0.05	0.02
Percentage of maximum specific gravity (see Note 1)		3% (see Note 2) 2% (see Note 4)	1% (see Note 3)
Design air voids content (see Note 1)	MS-2 Asphalt Mix Design Methods	2.8%	4.5%
Asphalt binder content	AASHTO T 308, Method A	0.3% 0.5%	0.1% 0.2%
Aggregate gradation	AASHTO T 30 and AASHTO T 308		
3/4-inch or 1/2-inch		3%	1%
3/8-inch		3%	1%
No. 4		3%	1%
No. 8		3%	1%
No. 30		3%	1%
No. 200		3%	1%

Notes:

1. Examine the AASHTO T 209, Method A, values for theoretical maximum density also. Determine whether resolution of AASHTO T 209, Method A, is necessary and sufficient to resolve issues with percent theoretical maximum density or design air void content.
2. Compare one core to the average of quality control test results within the same 250 tons.
3. Compare the average of Caltrans' cores to the average of quality control test results for the same volume of HMA or the same area.
4. Compare the average of 3 of Caltrans' cores in 3 lots of 250 tons each to the average of quality control test results for the same 3 lots of HMA.

4-3904C Certificates of Compliance

The resident engineer obtains certificates of compliance for each delivery of asphalt binder with the bill of lading, crumb rubber modifier, tack coat, and fog seal.

Keep track of total quantity of material delivered and check that inspectors have obtained an adequate number of certificates of compliance to cover the quantity of material received.

In addition, perform the following contract administration reviews for certificates of compliance:

- Refer to the *Certification Program for Suppliers of Asphalt* to determine what information must be shown on the certificate of compliance for asphalt binders.
- Obtain "Buy America" certification for each shipment of crumb rubber modifier.

Assure that asphalt binder contract administration requirements are met by following Section 4-92, "Asphalt Binders," of this manual.

4-3905 Level of Inspection

Suggested levels of field inspection for typical concrete pavement activities are:

- Benchmark inspection of subgrade for compaction and elevation requirements
- Intermittent inspection of HMA production operations
- Continuous inspection of HMA delivery, placement
- Continuous inspection of HMA compaction operation using method compaction specifications
- Benchmark inspection of HMA compaction operation using the core density compaction specifications
- Continuous acceptance sampling and testing of HMA
- Intermittent monitoring of the contractor's adherence to their quality control plan
- Benchmark evaluation of pavement surfacing for signs of segregation, raveling, or other distresses
- Benchmark inspection for smoothness

4-3906 Quality Control

Guidance for quality control activities included in this section is summarized as follows:

- Review contractor's quality control plan within 5 business days of the submittal. For the standard process, verify the plan complies with the requirements of Section 39-2.01A(3)(c) "Quality Control Plan," of the *Standard Specifications.* For the for Type-A HMA using the SPF process, verify the plan complies with the requirements of 39-2.09A(3)(b), "Quality Control Plan," of the special provisions. For RHMA-G using the SPF process, verify the plan complies with the requirements of 39-2.10A(3)(b), "Quality Control Plan," of the special provisions.

- Verify that the contractor submits a copy of the AASHTO re:source accreditation for the laboratory performing the mix design. A current list of accredited labs is available at:

  http://aashtoresource.org/aap/accreditation-directory

- For HMA placed using the SPF process, verify the contractor's quality control testing laboratories performing AASHTO tests have a current AASHTO re:source accreditation.
- For HMA placed using the SPF process, verify that the contractor's quality control testing laboratory and quality testing personnel are accredited and qualified under the Caltrans' Independent Assurance Program. The list of accredited and qualified laboratories and personnel are maintained in the *Statewide Independent Assurance Database (SIAD).* The SIAD is available at:

  https://sia.dot.ca.gov/index.php

  Review the contractor's quality control test results to verify that testing meets the specifications for Caltrans acceptance. For most quality control characteristics, the contractor samples and tests at a minimum frequency of once for every 750 tons of produced HMA.
- Verify that, when any quality characteristic is beyond the action limits shown in the quality control plan, the contractor is taking corrective action. The contractor must document the corrective action in accordance with Section 39-2.01A(4)(h), "Quality Control," of the *Standard Specifications*.
- Verify that the contractor is complying with the minimum quality control testing frequencies specified in Section 39-2.01, "General," and the frequencies specified under Section 39-2.01A(4)(h) "Quality Control," both of the *Standard Specifications*, for the type of HMA being produced.
- For HMA placed under the standard process, make sure the contractor stops production when 2 consecutive quality control or acceptance tests are out of specification, notifies the resident engineer, takes corrective action, and demonstrates compliance with the specifications before resuming production and placement of HMA.
- For HMA placed under the SPF process, make sure the contractor stops production when 2 consecutive non-pay factor quality control or acceptance tests are out of specification, notifies the resident engineer, takes corrective action, and demonstrates compliance with the specifications before resuming production and placement of HMA.
- Verify that certifications for the inertial profiler and operator have not expired. The corresponding expiration dates are available at:

  https://dot.ca.gov/programs/engineering-services/inertial-profiler-certification-program

- Review the contractor's monitoring of best paving practices that promote smoothness. Encourage the contractor to monitor and record locations where

paving practices commonly known to negatively affect smoothness occur, then to follow up and compare those locations to the localized roughness reports of the corresponding International Roughness Index values. Examples of common occurrences are: paver stops, excessive screed angle adjustments, excessive variation in head of material in front of screed from paving width adjustments or poor controls, variations in paving speed, poor or lack of automated grade controls using a ski or averaging system, or poor roller practices.

- Before paving, use MultiCool software to estimate how rapidly a freshly placed HMA mat will cool as a function of the mix properties and site conditions. The MultiCool software is available at:

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

  A MultiCool application is also available for smartphones using either the Android or iOS operating systems.

- Before placing tack coat, make sure the contractor plans to spray tack coat at a rate required to achieve the minimum residual rate. Rates vary based on the application and the dilution rate. To determine the minimum rate, calculate your own rate as shown in the example at 4-9403, "During the Course of Work," of this manual or use the "*Minimum Tack Coat Spray Rates* (PDF)" at:

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

4-3907 Payment

For details of payment, review the applicable, "Payment" subsection of Section 39 "Asphalt Concrete," of the *Standard Specifications*.

For guidelines on how to weigh HMA, refer to Section 3-902E, "Weighing Equipment and Procedures," of this manual.

For measuring asphalts, liquid asphalts, and asphaltic emulsions used as tack coat, refer to Sections 4-92, "Asphalt Binders"; and 4-94, "Asphaltic Emulsions," of this manual.

4-3907A Payment Adjustment for Core Density

For HMA placed using the standard process, determine if a deduction is required for cores outside specification limits for the percent of maximum theoretical density. Use the table, "Reduced Payment Factors for Percent of Maximum Theoretical Density," in Section 39-2.01A(4)(i)(ii), "In-Place Density," of the *Standard Specifications*. The core density deduction should be taken on the next monthly estimate as an administrative deduction.

4-3907B Compensation Adjustment for Price Index Fluctuations

For compensation adjustments for price index fluctuations for asphalt binder, use the guidance provided in Section 4-9205A "Compensation Adjustments for Price Index Fluctuations" of this manual.

4-3907C Payment After Dispute Resolution for Independent Third Parties

If applicable, when the dispute resolution process determines the contractor's test results are correct, Caltrans pays the independent third-party testing costs and adjusts the contract time. The resident engineer adjusts payment and contract time in accordance with Section 8-1.07, "Delays," of the *Standard Specifications* and processes a change order to allow for payment and adjustment.

4-3907D Compensation and Contract Time for Delays

When failing to comply with the specified times to return test results to the contractor, the resident engineer must adjust payment and contract time under Section 8-1.07, "Delays," of the *Standard Specifications*:

- Within 20 days of sampling for job mix formula verification
- Within 3 days of rubberized HMA production sampling for job mix formula verification
- Within 3 days of sampling for production start-up evaluation

Make compensation and contract time adjustments only when work completion is delayed.

4-3907E Compensation Adjustment for Hot Mix Asphalt Placed Using the Statistical Pay Factor Specifications

The resident engineer determines acceptance of each lot of HMA placed using the SPF process using guidance in Section 4-3904A (4), "Acceptance of Lots Using Statistical Pay Factor Specifications" of this manual.

Once a lot is accepted, the resident engineer uses the SPFPay spreadsheet to determine the composite quality factor for the lot. The composite quality factor is the weighted average of the individual quality factors for each of the 5 pay factor quality characteristics, rounded to 2 decimal places. The individual quality factors are not rounded before determining the composite quality factor.

The resident engineer then uses the composite quality factor for the lot and the contractor's bid item price to determine the unit price adjustment. That unit price adjustment is then applied to each ton of HMA placed in the accepted lot. The unit price adjustment per ton is determined as follows:

> Unit price adjustment for lot equals the composite quality factor minus 1.00 multiplied by the HMA bid price

Using the unit price adjustment equation, if the composite quality factor is 1.05, the contractor earns a 5 percent incentive, or if the composite quality factor is 0.95, the contractor earns 5 percent less, which is a disincentive.

The resident engineer includes the applicable adjustment on the next progress estimate after the lot has been accepted and the adjustment has not been disputed. When the adjustment is not included on the next progress estimate, and the amount is an incentive, the resident engineer includes it on the next progress estimate and

pays interest calculated in accordance with the requirements of Section 9-1.03, "Payment Scope," of the *Standard Specifications.*

When the engineer's test data does not verify the contractor's test data, the engineer immediately notifies the contractor and uses the Caltrans verification test data in place of the contractor's quality control test data as basis for acceptance and determination of a payment adjustment.

If the contractor disputes the non-verification, the engineer follows the dispute process defined in the specifications. For Type-A HMA, refer to section 39-2.09A(4)(c)(v), "Dispute Resolution" of the project's special provisions. For RHMA-G, refer to section 39-2.10A(4)(c)(v), "Dispute Resolution" of the project's special provisions.

If the contractor disputes the engineer's non-verification of the lot, the specifications require that both parties first attempt to resolve the dispute without involvement of an independent third party. This may include witness testing and sharing of test data worksheets. If this first step does not resolve the dispute, the engineer provides the split samples from the engineer's disputed verification test samples to the independent third party, who runs the tests on those samples. Those test results are used in the verification test of the contractor's quality control samples reported for the lot.

If the independent test results verify the contractor's test results, the lot is considered verified and the payment adjustment is determined using the contractor quality control test data. The engineer then pays for the independent testing costs.

If the independent test results do not verify the contractor's test results, the lot is not verified, and the payment adjustment is determined using the independent test results. The contractor then pays the independent third-party testing costs.

4-3908 References and Resources

The following provide Construction personnel with additional sources of information:

4-3908A References

- Authorized Materials Lists (AML):

  https://dot.ca.gov/programs/engineering-services/authorized-materials-lists
- California Test Methods, METS:

  https://dot.ca.gov/programs/engineering-services/california-test-methods
- Certification Program for Suppliers of Asphalt, METS:

  https://mets.dot.ca.gov/aml/AsphaltBindersList.php
- CEM forms, Division of Construction:

  https://dot.ca.gov/programs/construction/forms
- *Independent Assurance Manual*, Procedures for Accreditation of Laboratories and Qualification of Testers, METS:

https://dot.ca.gov/programs/engineering-services/independent-assurance-program

- Material Plant Quality Program, Division of Construction:

  https://dot.ca.gov/programs/construction/material-plant-quality-program
- Materials Engineering and Testing Services (METS), Caltrans, part of the Division of Engineering Services.
- Maintenance Technical Advisory Guide (MTAG) in two parts, with contact information on the Division of Maintenance's Pavement Preservation Program page.
- *Quality Control Manual for Hot Mix Asphalt using Statistical Pay Factors*:

  https://dot.ca.gov/programs/construction/hot-mix-asphalt-construction
- *Construction of Quality Asphalt Pavements*, Asphalt Institute:

  https://bookstore.asphaltinstitute.org/
- *Standard Specifications*, Caltrans:

  https://design.onramp.dot.ca.gov/2023-standards
- *Tack Coat Guidelines*, Division of Construction:

  https://dot.ca.gov/programs/construction/hot-mix-asphalt-construction
- Minimum Tack Coat Spray Rates, Division of Construction:

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

4-3908B Resources

Use available experts within your district or region to resolve issues and obtain additional information about HMA production and placement. Contact the construction engineer and Division of Construction coordinator for issues about contract administration related to HMA specifications. Contact the district materials engineer for issues about materials and the district independent assurance coordinator for issues concerning testing.

When questions about Section 39, "Asphalt Concrete," of the *Standard Specifications* or related special provisions cannot be addressed by district or region experts, or the construction engineer refers the resident engineer to the Division of Construction or Engineering Services for assistance, contact the following:

For materials or testing issues:

Chief, Office of Central Laboratories
Materials Engineering and Testing Services
California Department of Transportation

For contract administration, measurement or payment issues:

Chief, Office of Construction Standards
Division of Construction
California Department of Transportation

Chapter 4 Construction Details

Section 40 Concrete Pavement

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Figure 4-40.1. Primary Cores

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Chapter 4 Construction Details

Section 40 Concrete Pavement

4-4001 General

This section covers concrete pavement including:

- Preparation of concrete pavement subgrade
- Production of the concrete
- Concrete pavement equipment requirements
- Placing, finishing, and curing of the concrete pavement
- Construction of joints
- Protection of the pavement
- Noncompliant pavement work

Plant inspection specialists and testing personnel usually perform inspection and testing duties at the concrete batch plant. However, in addition to onsite inspection, mix design authorization and plant inspection are part of the resident engineer's responsibility. Good communication between plant and inspection specialists and assistant resident engineers is essential. Inspectors and assistants must inform the resident engineer of test results in a timely manner.

This section covers mostly onsite inspection duties. For information on producing and transporting concrete, refer to Section 4-90, "Concrete," of this manual.

4-4002 Before Work Begins

4-4002A General

- Review the plans and specifications to determine the requirements for concrete pavement, including submittals, quality assurance, materials, construction, and payment provisions.
- Coordinate and hold a preconstruction meeting with the specified contractor's personnel before paving activities, including any test strips. Refer to Section 36-1.01D(2), "Preconstruction Meetings," of the *Standard Specifications*. Discuss the contractor's methods for performing each element of the work, including those identified in the quality control plan. For jointed plain concrete pavements (JPCP), include discussions on the contractor's methods for assuring proper dowel and tie bar placement relative to constructed contraction joints and their early age crack mitigation system.
- Decide if crossings will be necessary for the convenience of public traffic and whether rapid strength concrete should be used for such crossings. Advise the contractor accordingly.

- When long hauls are involved, review the contractor's proposed placement method to verify that adequate time will be available.
- Discuss pavement areas to receive tapered edge with the contractor and construction methods to be used.
- For concrete pavement widenings placed adjacent to existing pavements, make sure the existing pavement lane or shoulder is ground before new concrete is placed. New concrete pavement must match the grounded existing surfaces and meet specified smoothness requirements.
- Arrange for plant inspection and testing personnel to be present at the plant before startup.

4-4002B Submittals

- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes concrete pavement materials. Refer to Section 6-202, "Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products," of this manual for additional information.
- Review the contractor's proposed concrete mix design for conformance with specification requirements. The contractor's mix design submittal is to include a copy of their American Association of State Highway and Transportation Officials (AASHTO) accreditation for their laboratory determining the mix proportions and laboratory test reports including modulus of rupture information, compressive strength, and shrinkage test data. AASHTO laboratory accreditation can be verified at the AASHTO resource website:

  http://aashtoresource.org/aap/accreditation-directory
- Determine the pavement climate region for your project by reviewing the pavement design information located on the typical cross section sheet, which may trigger additional concrete mix requirements such as required air entrainment. Refer to Section 4-90, "Concrete," of this manual for information on concrete mix designs. Assistance with the concrete mix design review may be obtained from the district materials engineer.
- Verify that the aggregate material source complies with Section 7-103H (2), "Surface Mining and Reclamation Act," of this manual.
- Obtain the contractor's quality control plan that details the methods the contractor will use to assure the quality of the work. Review the quality control plan for conformance with specification requirements. Check that the quality control plan has met or exceeded the quality control testing requirements specified in the contract. Make sure that individual suspension limits do not exceed specified acceptance criteria. If requested by the contractor or desired by the resident engineer, hold a separate meeting to discuss the quality control plan that addresses each element affecting pavement quality, including those specified in Section 40-1.01D(3), "Quality Control Plan," of the *Standard Specifications*. For JPCP, pay extra attention to the contractor's plan for proper placement of contraction joints, dowel bars, and tie bars, as well as their planned early age

crack mitigation system. The district materials engineer may be available to provide subject matter expertise at this meeting.

- When just-in-time (JIT) training is specified, obtain the contractor's JIT training submittal containing the instructor's name and qualifications, training location, course syllabus, handouts, and presentation materials. You may waive JIT training requirements for individuals who have attended equivalent JIT training within the last 12 months and have provided certification of completion documentation.
- Obtain certificates of compliance when tie bars, threaded tie bar splice couplers, dowel bars, tie bar baskets, dowel bar baskets, joint filler material, and epoxy powder coating items are to be used in concrete pavement.
- For JPCP, check that the early age crack mitigation system information is provided a minimum of 24 hours in advance of each paving shift and based on predicted weather conditions for the site, including wind speed, ambient temperatures, humidity, and cloud cover. The system assists the contractor in predicting concrete stresses and strength during the initial 72 hours after paving for constructing contraction joints, cure application, and crack mitigation. Verify that the contractor employs the specified portable weather station at the paving site to monitor, update, and report predictions.
- Obtain calibration documentation and operational guidelines for frequency measuring devices for concrete consolidation vibrators.
- For cold weather conditions, obtain the contractor's plan for protecting concrete pavement.
- Obtain the name of the contractor's independent third-party air content testing laboratory when the project is located in a pavement climate region requiring air entrainment. A freeze-thaw area would require air entrainment.
- Obtain the manufacturer's recommendations and instructions for storage and installation when threaded tie bar splice couplers and joint filler material items are to be used in concrete pavement.
- For continuously reinforced concrete pavements, obtain a plastic chair submittal and plastic chair sample if their use is proposed by the contractor. Refer to Section 40-2.01C, "Submittals," of the *Standard Specifications* for additional information.
- Obtain physical specimens used for the contractor's testing of coefficient of thermal expansion. Make sure the contractor provides test data at field qualification and throughout production as specified. The contractor is also required to submit this test data electronically to the specified website. Note that for continuously reinforced concrete pavements, there is specified acceptance criteria for coefficient of thermal expansion at field qualification; otherwise, this is provided for information only.

4-4002C Training

- Make sure that JIT training is conducted in conformance with contract provisions.

4-4002D Concrete Field Qualification and Pavement Test Strip

- Verify that field qualification of proposed mix proportions is performed by an American Concrete Institute-certified Concrete Laboratory Testing Technician, Level 1. Obtain copies of certifications for project records. Review concrete field qualification data and certified test reports for conformance with contract requirements.
- Verify that the contractor performs coefficient of thermal expansion sampling, specimen fabrication, and testing as specified. For continuously reinforced concrete pavements, make sure the coefficient of thermal expansion test values meet acceptance criteria as a condition of qualification. Contractor submitted test specimens may be used to verify test results.
- For projects with concrete pavement volumes exceeding 2,000 cubic yards, make sure a test strip is constructed for evaluating compliance with specification acceptance criteria including smoothness; dowel bar and tie bar placement for JPCP; vertical and lateral stability of reinforcement; and plastic chairs, if proposed, for continuously reinforced concrete pavements, thickness, and final finishing. Test strips not meeting requirements are rejected. Make sure an authorized test strip has been constructed before production paving. Additional test strips are required if the contractor changes the intended method of placement or concrete mix proportions or where a test strip has been rejected. Check that arrangements are made to evaluate the test strip within 3 business days of placement. Requests to eliminate the test strip should only be considered when the contractor can fully document that the same personnel and equipment have been successful in completing the same concrete pavement type within the last 12 months on a Caltrans project.

4-4003 During the Course of Work

4-4003A Prepaving

- Before the start of paving, check the accuracy of the final grade stakes.
- Inspect the subgrade to verify compliance with the specified tolerances for compaction and elevation requirements. Make sure that loose and extraneous materials are removed before paving. Check that any low areas are identified in a way that will result in placing additional concrete as specified. Such additional thickness is considered paid for as part of the lower layer and must not be included when calculating pavement thickness and payment. Refer to the applicable specifications for cement-treated base, lean concrete base, and treated permeable bases. Note these areas in daily reports with stationing and offset information.
- To maintain the concrete pavement at the thickness specified, the contractor may adjust the planned finished grade provided 2 conditions are met:

1. All lower layers have been constructed to at least the minimum required elevations.
2. Such adjustments do not result in abrupt changes in grade or adversely affect smoothness. General practice is to limit any such adjustment so that the planned finished grade does not change more than 0.04 foot in 60 feet longitudinally.

- When slip-form pavers are used, inspect the grade on which the paver will ride to determine if the grade is smooth enough to prevent abrupt vertical changes in the finished surface. When a wire controls the grade and alignment of the paver, check the wire for any obvious variations. Check that the wire is tensioned sufficiently to prevent measurable sag between supporting stakes. If you anticipate any problems, advise the contractor. Keep in mind that the contractor is responsible for the thickness and smoothness of the pavement.
- Identify where the contractor will post quality control charts.
- Check that any specified bond breaker material, curing seal, or other required treatment has been applied and maintained on the underlying material in conformance with contract requirements. Refer to Section 36-2, “Base Bond Breaker,” of the *Standard Specifications* and Section 4-36, “Surfacing and Pavements—General,” of this manual for additional information on base bond breakers. These materials may also be helpful for determining pavement thicknesses when examining pavement cores.
- Examine the equipment or tools to be used. When obvious inadequacies exist, advise the contractor and record the details in the daily report. Do the following in examining equipment or tools:
    1. For side-form construction:
        a. Examine the forms for specified attributes, including those for composition, weight, dimensions, and rigidity. Check that the forms are cleaned and oiled before each use.
        b. Verify that installation of the forms complies with specifications. Order any necessary corrective work before the placement of concrete.
        c. Inspect the paving equipment for specification compliance.
    2. For slip-form construction, examine the paver for the specified attributes.
    3. Regardless of which method of construction is used, check that the contractor uses proper consolidation techniques that produce uniform concrete without segregation. Where vibrators are used, make sure they are operated in conformance with contract requirements.
    4. To verify compliance with the requirements for protecting pavement, examine all equipment that will be placed on previously completed pavement.
- Check that a sufficient water supply is available for the work.

- Before concrete placement, check that the subgrade is uniformly moist, but free from standing or flowing water.
- Based on the concrete pavement climate region, verify the types of reinforcement, tie bars, dowel bars, tie bar baskets, and dowel bar baskets to be used within the concrete pavement. Refer to Section 40-1.02C, "Reinforcement, Bars, and Baskets," of the *Standard Specifications*. For continuously reinforced concrete pavements, spot check reinforcement for size, spacing, vertical positioning, clearance, and stability. For JPCP using dowel bar or tie bar baskets, spot check their anchorage to the base material. If dowel bar or tie bar inserters are used, verify that the contractor is checking inserter alignment before the pour. Check that the specified dowel bar lubricant has been properly applied. Verify that the contractor's quality control methods for properly locating contraction joints, dowel bars, and tie bars are being applied.
- Verify that equipment for constructing joints is onsite and that it conforms to specifications.
- For JPCP, verify that the contractor has updated their early age crack mitigation system with the most current weather forecast information and field conditions; for example, grade and concrete temperatures. Discuss any adjustment in their construction operations as a result of predicted weather.
- Determine the curing method the contractor proposes to use. When a curing compound will be used, discuss the labeling and packaging requirements for acceptance of the compound with the contractor. Obtain a certificate of compliance, including required test results, for each batch of curing compound.
- Verify that equipment and materials meeting the requirements of Section 90-1.03B(3), "Curing Compound Method," or Section 90-1.03B(4), "Waterproof Membrane Method," of the *Standard Specifications* are onsite.
- If paving or finishing operations will extend beyond daylight hours, check that adequate lighting facilities are on the project before paving begins.

4-4003B Paving

- Maintain good communication between field personnel inspecting the placing portion of the paving operation and plant inspection personnel, so that problems related to mixing or hauling may be addressed and corrected effectively.
- Refer to Section 4-90, "Concrete," of this manual for a discussion of transporting concrete and receiving weighmaster certificates at the delivery point.
- Check that the contractor furnishes the required tachometer. Also, be sure the contractor does the vibrating at the locations and in the frequencies and amplitudes specified. Be alert for inoperative units, and verify that they are replaced immediately.
- Watch for improper proportions or inadequate mixing as concrete is placed. In the daily report, record the reasons for any concrete rejection and the approximate amount involved.

- Observe the operation of equipment on existing pavements to make sure no cracking or other damage occurs. If damage occurs, order immediate corrective action.
- At the start of each day's work, check that the specified date stamp is used to mark the new pavement.
- Make sure acceptance testing is performed on concrete pavement in accordance with Section 40-1.01D(8), "Department Acceptance" of the *Standard Specifications* and Section 6-1, "Sample Types and Frequencies," of this manual for the identified quality characteristics.
- For California Test 523, "Method of Test for Flexural Strength of Concrete (Modulus of Rupture)," select a location to store concrete beams. A good location is one convenient to a water source and removed from any traffic. Require the contractor to supply sufficient sand or earth for burying the beams. Arrange for the contractor also to supply labor for assistance with transporting and burying the beams. Note the safety precautions in the test method.
- Check that sufficient beam samples are molded for modulus of rupture testing to determine acceptable flexural strength when pavement crossings will be open to public traffic or to job traffic earlier than normally permitted. Make sure fabricated beams are properly handled, cured, and transported before testing.

  California Test 523 follows ASTM C31, "Standard Practice for Making and Curing Concrete Test Specimens in the Field," for making and curing concrete test specimens.

  For the beam fabrication, use the information in Tables 40.1., "Beam Size," Table 40.2., "Consolidation," and Table 40.3., "Molding," as described in ASTM C31, Sections 6, Testing Requirements," and 9, "Molding Specimens."

Table 40.1. Beam Size

Minimum Cross-Sectional Dimension of Beams	
Nominal Maximum Aggregate Size (in)	**Minimum Cross-Sectional Dimension (in)**
Less than or equal to 1	4 x 4
Greater than 1, through 2	6 x 6

Table 40.2. Consolidation

Method of Consolidation Requirements	
Slump (in)	**Method of Consolidation**
Equal to or greater than 1	Rodding or vibration
Less than 1	Vibration

Table 40.3. Molding

Molding Requirements	
Consolidation Method	**Number of Layers of Equal Depth**
Rodding	2
Vibration	1

Curing of beams: Initial curing and field curing for traffic opening are described in the following paragraphs.

Initial Curing: Store standard-cured specimens for as long as 48 hours after molding, while maintaining the temperature and moisture conditions specified in ASTM C31, Section 10.1.2.1., and in Table 4-40.4., “Curing and Strength.”

Temperature range varies according to the specified concrete strength, as summarized in ASTM C31, Section 10.1.2.1.

Table 40.4. Curing and Strength

Concrete Strength (psi)	Initial Curing Temperature Range (˚F)
Less than 6,000	60 - 80
Equal to or greater than 6,000	68 - 78

A satisfactory temperature environment can be created during the initial curing of the specimens by one or more of the following procedures: (1) use of ventilation; (2) use of ice; (3) use of cooling devices; or (4) use of heating devices, such as electrical resistance heaters or light bulbs. Other suitable methods may be used if the temperature requirements are met.

A satisfactory moisture environment can be created during the initial curing of the specimens by one or more of the following procedures: (1) immerse molded specimens with plastic lids in water; (2) store specimens in a container or enclosure; (3) place specimens in damp sand pits; (4) cover specimens with plastic lids; (5) place specimens inside plastic bags; or (6) cover specimens with wet fabric. Immersion in water may be the easiest method to maintain required moisture and temperature conditions during initial curing.

Field Curing for Traffic Opening: As nearly as practical, cure beams in the same manner as the concrete in the pavement. To meet these conditions, specimens made for determining when the pavement may be open to traffic must be removed from the molds 44-52 hours after molding. Store specimens representing pavement on the ground as molded, with their top surfaces up. Bank the sides and ends of the specimens with earth or sand that must be kept damp, leaving the top surfaces exposed to the specified curing treatment. Store concrete pavement specimens as near as possible to the pavement they represent. Provide specimens with the same temperature protection and moisture environment as the concrete pavement they are representing. At the end of the curing period, leave the specimens in place, exposed to the weather in the same manner as the concrete pavement. Remove all

beam specimens from field storage and store in water saturated with calcium hydroxide at 70-77 degrees Fahrenheit for 20-28 hours immediately before time of testing to assure uniform moisture condition.

- Where air entraining admixtures are required by the project's pavement climate region, in accordance with Section 40-1.02B(4), "Air Entrainment," of the *Standard Specifications*, perform verification testing and use quality control testing for acceptance for air content of concrete pavement. Follow the contractual procedure specified in Section 40-1.01D(8)(b)(ii), "Air Content" of the *Standard Specifications*.
- Monitor the contractor's conformance with their quality control plan. Verify that control charts for required quality control tests are being updated on each day of paving and adhere to the quality control plan, including action and suspension limits. When deficiencies are observed, notify the contractor and document in the daily report. When deficiencies are not resolved or continue to occur, suspend the contractor's pavement operations until the contractor provides satisfactory assurances and written documentation of their corrective plans. Where appreciable differences are encountered between the quality control tests and acceptance tests, investigate and resolve these concerns with aid of the district materials engineer as necessary.
- Verify that the contractor performs coefficient of thermal expansion sampling and specimen fabrication and submits test results and specimens as specified.
- For JPCP, check that dowel bar baskets, tie bar baskets, and the bars themselves are not being displaced during the concrete placement and paving operations. Check that the contractor is properly identifying and constructing contraction joints relative to pavement references and bar centroids in conformance with the contract requirements and the contractor's quality control plan.
- For JPCP, monitor the contractor's timelines from concrete placement to curing application and contraction joint sawing in comparison to their planned schedule from their early age crack mitigation system. Notify the contractor promptly of any deviations and record this information in the daily report along with the location of the work.
- When joints are to be formed rather than sawed, be sure joint material is placed as specified.
- Verify that the contractor constructs a transverse construction joint if the time interval between two successive concrete loads is greater than the specification allowance. Check that such joints are constructed at permissible contraction joint locations.
- Caution the contractor to construct the pavement so it will meet requirements for inertial profile, straightedge, and edge slump before final finishing to minimize corrective work. Inconsistent delivery and nonuniformity of concrete can affect paver performance and have negative effects on the paved surface. Where encountered, document these locations in the field and within the daily record.

- Measure the pavement's width at the beginning of and periodically after paving. While the required width applies to both upper and lower surfaces, the bottom width can be greater than specified to reduce edge slump.
- Check that end anchors are constructed at all required locations and to the dimensions shown on the plans. Be sure transverse contact joints are constructed and tie bars and dowels are placed as shown on the plans. When required, check that pressure relief joints are constructed as specified and shown on the plans.

4-4003C Finishing Pavement

- Make sure the contractor performs preliminary finishing according to specifications and in a way that imparts the desired surface characteristics.
- During concrete finishing observations, consider the following information:
    1. Pavement can be durable with inadequate texture or be well textured and not have enough durability to retain the texture.
    2. Mixing water with surface mortar during finishing reduces surface durability. This mixture may result from "bleed" water that had not evaporated, water that was added to the surface to make finishing easier, or water that was added to prevent hairline cracking and checking.
    3. If any of the concrete visible during finishing is more dilute than the mortar of the freshly placed concrete, too much water is being mixed into the surface. Telltale signs of the unacceptable practice include:
        a. Soupy mortar during finishing
        b. Excess laitance
        c. Small scallops in the slab's edge
        d. Areas still soft and wet in the finished surface while the surrounding area has turned firm and lost its watery sheen
    4. Standing bleed water may appear on the surface under certain conditions shortly after pavement is placed. To avoid mixing bleed water with surface grout, complete preliminary finishing before bleeding progresses to this degree.
    5. Water applied for the convenience of finishing, not otherwise needed to produce the specified product, is contrary to specifications regarding water use for retempering.
- Check that the contractor performs the final finishing as specified and in a way that results in a finished surface with the desired characteristics.
- When sufficient rain may fall to damage fresh pavement, stop pavement placement or verify that other steps, such as covering, are taken to prevent damage.

- Before texturing, check that the contractor rounds the pavement edges to specified radii. Observe texturing for compliance with requirements. Verify that the contractor performs initial texturing with a broom or burlap drag to produce striations parallel to the centerline.
- Check that burlap drags are used as specified and kept sufficiently clean to avoid irregularities in the texture. Brooms used must also be kept sufficiently clean to avoid significant irregularities. Final texturing must be done with spring-steel tines that produce grooves parallel to the centerline. Grooves not straight and parallel to the centerline are unacceptable. Grooves are to be constructed over the entire pavement width with the exception of within 3 inches of pavement edges and longitudinal joints. Make sure the cross section of the steel tines complies with specifications. Inspect the pavement surface to verify that grooves meet the specified depth.
- Before and after the application of curing seal, make sure that the contractor keeps the pavement surface moist as specified.
- Verify that the contractor uses either the waterproof membrane method or curing compound method specified in Section 90-1.03B, “Curing Concrete,” of the *Standard Specifications*. During observations, also note the following:

    1. Waterproof membrane:

        a. Make sure the contractor sprays the concrete with a mist of water until the concrete has set before placing the membrane. Make sure water does not flow over or wash the concrete surface.

        b. Examine the waterproof membrane to see that it meets specifications. For assistance, consult the district materials engineer.

        c. Verify that membrane material is placed and secured and that any damaged sheeting is repaired as the specifications require.

        d. If polyethylene sheeting is used, monitor maximum concrete temperatures during curing, checking that the maximum allowable is not exceeded.

        e. Make sure the contractor adheres to the specified curing period.

    2. Curing compound:

        a. Check that the contractor applies the curing compound uniformly after tining. See that sawed cuts or other disturbed areas receive additional curing compound. Your inspection should verify the following attributes for the compound:

            (1) It is not contaminated, diluted, or altered before application.

            (2) It is mixed thoroughly before application.

            (3) It is applied when concrete surfaces are still visibly moist.

            (4) The curing film remains unbroken for the specified duration of curing.

        b. Perform measurements and calculations for the curing seal’s application rate. To determine the rate, you may use California Test 535, “Method of

Test for the Application Rate of Concrete Curing Compound in the Field." Record the measurements in the daily report.

- Verify that concrete pavement joints are constructed in conformance with Section 40-1.03B, "Joints" of the *Standard Specifications*; the contractor's quality control plan, and the contractor's early age crack mitigation system for JPCP. Longitudinal and transverse contraction joints must be sawed before cracking occurs and after the concrete is hard enough to saw without spalling, raveling, or tearing. The contractor is responsible for determining the exact time of sawing. Check that concrete debris, water residue, and paste are immediately removed during saw cutting operations and that slurry from the sawing operation is immediately washed from the joint and removed. Where spalling, raveling, and tearing are observed, make sure the contractor performs repairs in conformance with Section 40-1.03N, "Spall and Ravel Repair," of the *Standard Specifications*.
- Check that concrete pavement temperature is maintained above 40 degrees Fahrenheit during the initial 72 hours after placement.

4-4003D Post-Paving

- Identify where core locations are to be taken by the contractor. Obtain core submittals throughout pavement operations for determining pavement thickness and air entrainment, which is required when the contractor's quality control air entrainment test results are not verified by Caltrans testing. For JPCP, obtain cores for evaluating dowel and tie bar placement and concrete consolidation in these areas. Verify that specified placement tolerances have not been exceeded relative to constructed contraction joints and orientation of pavement edges.
- For JPCP, examine concrete pavement surfaces once the cure period is complete. If necessary, order the contractor to obtain concrete cores for further evaluation. Pavement slabs with full depth cracks other than working cracks require the removal and replacement of slab or slab portions. Refer to Section 40-4.03B, "Correcting Noncompliant Pavement Work," and Section 40-4.03C, "Correcting Cracks" in the *Standard Specifications* for further information on replacing JPCP and correcting JPCP cracks. Spall or ravel areas larger than specified allowance in Section 40-1.03N, "Spall and Ravel Repair," must be repaired under Section 41-4, "Spall Repair," of the *Standard Specifications*. Slabs with combined raveled areas greater than 5 percent of the slab area or with a single area of more than 4 square feet must be removed and replaced.
- For continuously reinforced concrete pavements (CRCP), examine pavement surfaces for cracking and raveling. Refer to Section 40-2.03D, "Correcting Noncompliant Pavement Work," of the *Standard Specifications*, for partial depth and full-depth repairs. High molecular weight methacrylate is not to be applied to any cracks in CRCP.
- Verify that the contractor performs inertial profiling on specified areas. Refer to Section 36-3, "Pavement Smoothness," of the *Standard Specifications* and Section 4-36, "Surfacing and Pavements—General," of this manual for additional information. Areas requiring correction for smoothness may be ground under

Section 42-3, “Grinding,” of the *Standard Specifications*, subject to meeting minimum pavement thickness requirements. Alternatively, these noncompliant areas may be removed and replaced.

- Caltrans verifies and accepts pavement smoothness based on the results of the contractor’s inertial profiler testing under Section 36-3.

  For grinding existing concrete pavement, measure profile:

  1. Before any work is performed to calculate existing MRI
  2. After any pavement replacement work is performed, but before grinding to calculate baseline MRI
  3. After grinding is complete to calculate final MRI

  For all other concrete pavement project types, measure profile:

  1. After placing concrete but before performing any smoothness correction to calculate pavement MRI
  2. After performing any smoothness correction to calculate final MRI

- Obtain contractor’s inertial profiler information and reports for each day of inertial profiling of concrete pavement. Refer to Section 36-3, “Pavement Smoothness,” of the *Standard Specifications* and Section 4-36, “Surfacing and Pavements—General,” of this manual for additional information.
- Arrange through the district for inertial profile verification testing for pavement smoothness. Pavement areas not subject to inertial profiling requirements must meet specified straightedge requirements.
- Pavement smoothness is measured in accordance with Section 36-3, “Pavement Smoothness,” of the *Standard Specifications*. The Tables 40.5., “Pavement Type,” 40.6., “Target 60 Smoothness,” 40.7., “Target 67.5 Smoothness,” 40.8., “Target 75 Smoothness,” and 40.9., “Percent Improvement,” show the pavement and project types along with the applicable smoothness. A partial section less than 0.05 miles will not receive proportional pay adjustment but must still meet ALR thresholds. No ALR greater than 160 inches per mile is allowed, except when grinding existing pavement. There are no ALR requirements for grinding existing pavement.

Table 40.5. Pavement Type Smoothness Selection

Pavement Type	Project Type	Smoothness Table
CRCP	New alignment	Target 60
CRCP	Widening or lane replacement	Target 67.5
JPCP	New alignment	Target 67.5
JPCP	Widening or lane replacement	Target 75
CRCP/JPCP	Grinding existing concrete pavement	Percent Improvement

Table 40.6. Target 60 Smoothness

0.1-mi MRI (in/mi)	Pay Adjustment/0.1 mi	Corrective Action (Note 1)
≤ 45.00	+ $1,500	None
45.01–55.00	+ [(55 - *MRI*) x $150]	None
55.01–65.00	0	None
65.01–80.00	- [(*MRI* - 65) x $150]	Optional (Note 2)
> 80.00	--	Mandatory (Note 3)

Note 1: Corrective action must not reduce pavement thickness below minimums in section 40-1.01D(8)(c)(iv), "Thickness," of the *Standard Specifications*. Applicable to MRI only.
Note 2: Diamond grinding allowed.
Note 3: Correction is diamond grinding.

Table 40.7. Target 67.5 Smoothness

0.1-mi MRI (in/mi)	Pay Adjustment/0.1 mi	Corrective Action (Note 1)
≤ 50.00	+ $1,500	None
50.01–60.00	+ [(60 - *MRI*) x $150]	None
60.01–75.00	0	None
75.01–90.00	- [(*MRI* - 75) x $150]	Optional (Note 2)
> 90.00	--	Mandatory (Note 3)

Note 1: Corrective action must not reduce pavement thickness below minimums in section 40-1.01D(8)(c)(iv). Applicable to MRI only.
Note 2: Diamond grinding allowed.
Note 3: Correction is diamond grinding.

Table 40.8. Target 75 Smoothness

0.1-mi MRI (in/mi)	Pay Adjustment/ 0.1 mi	Corrective Action (Note 1)
≤ 50.00	+ $1,500	None
50.0–60.00	+ [(60 - *MRI*) x $150]	None
60.01–90.00	0	None
> 90.00	--	Mandatory (Note 2)

Note 1: Corrective action must not reduce pavement thickness below minimums in section 40-1.01D(8)(c)(iv). Applicable to MRI only.
Note 2: Mandatory correction is diamond grinding.

Table 40.9. Percent Improvement

0.1-mi MRI_{exist} (Note 1)(in/mi)	**0.1-mi MRI_{final} (Note 2) (in/mi)**	**Corrective Action**
≤ 100	≤ 60	None
≤ 100	>60	Mandatory (Note 3)
> 100	≤ 0.6 x MRI_{exist}	None
> 100	> 0.6 x MRI_{exist}	Mandatory (Note 3)

Note 1: Existing MRI.

Note 2: Final MRI.

Note 3: Mandatory correction is another pass of diamond grinding.

- Caltrans does not pay for mandatory smoothness corrections. Grinding to improve pay to positive pay adjustments is allowed if thickness is not deficient in accordance with Section 40-1.01D(8)(c)(iv), "Thickness," of the *Standard Specifications*. Pavement smoothness pay adjustments are applied in addition to other pay adjustments.
-
- After any required corrective grinding, determine locations where coring for thickness will be performed by the contractor. Observe coring operations and obtain drilled corings in properly identified plastic bags from the contractor. Use cores to determine acceptance of concrete pavement thickness. Do not allow coring machines on fresh concrete while any danger exists of damaging the concrete. Wait at least 72 hours.
- Check that any required rumble strips are ground into the concrete pavement after the minimum specified time and strength have been obtained. Verify that the completed rumble strip conforms to the tolerances for alignment, spacing, depth, length, and width. Make sure equipment noise restrictions are met. Refer to Section 84-8, "Rumble Strips," of the *Standard Specifications* for additional information.
- Obtain contractor's plan if repair or replacement of noncompliant concrete pavement is required.

4-4003E Measurement of Pavement Thickness

Use the following procedure for determining pavement thickness and any applicable deductions:

- Cores taken in each primary unit of pavement at the minimum specified rate and cores in primary unit areas taken at the contractor's request are referred to as primary cores.
- Primary cores do not include cores taken for secondary thickness measurements. Cores taken to determine the limits of secondary units are referred to as secondary cores.

- Before coring begins in primary units, designate areas where coring is excluded. Limit excluded areas to the following:
  - Dig-out spots in the subgrade
  - Thickened slabs at bridge approaches
  - End anchors
  - Local areas where authorized modifications to the planned pavement thickness have been permitted
- Do not exclude portions of the primary unit where equipment had difficulty or where unauthorized deviations from planned pavement thickness occurred.

4-4003E (1) Location of Primary Cores

Do the following to locate primary cores:

- For each pavement thickness on each day's paving, determine the net area, in square yards, of pavement placed, excluding the area of structures and other areas on which pavement is not placed during that day. The resulting measurement is the area of the primary unit. Divide the area of the primary unit by 1,200 square yards and take the next highest whole number. The resulting number is the number of primary cores to be taken, unless the contractor requests additional ones.
- Divide the net length of the primary unit by the number of primary cores to be taken in that unit. The resulting distance is the primary coring interval.

Locate the first core in any primary unit by starting at either end of the unit, preferably proceeding in the direction of increasing stations, and select a lane at random. Select any factor from the longitudinal factors shown in Table 4-40.10., “Calculation Factors to Locate Cores,” in this manual, and multiply the factor by the primary coring interval. The result is the distance from the beginning of the primary unit to the first core. Any random method of selecting the longitudinal location of the first core is within the intent of the specification. Determine the lateral location of the first core by selecting a value from the lateral column shown in Table 4-40.10 and measuring that distance from the right-hand edge of the lane selected.

Table 4-40.10. Calculation Factors to Locate Cores

Longitudinal (Factor)	Lateral (Feet)
0.6	6
0.1	10
0.2	2
0.9	9
0.5	5
0.7	7
0.4	4

0.8	8
0.3	3

- In turn, locate the remaining primary cores in the lanes. Space them uniformly, from the first core in the unit, at longitudinal intervals equal in length to the primary coring interval for the unit. Then locate them laterally within each lane as used for the first core by applying successive values from the lateral factors in Table 4-40.10. All values in the table are to be used successively for each primary unit throughout the project after the value for the first core in the unit is selected at random. The location of each core should be spotted on the pavement within "pacing accuracy" longitudinally and within about 1 foot laterally.

4-4003E (2) Location of Secondary Cores

To determine the limits of secondary units, locate cores in approximately the center of each adjacent panel. Note that for continuously reinforced concrete pavements, panel lengths are defined as 15 feet for this purpose.

4-4003E (3) Thickness Variation

For all cores, determine the pavement thickness variation by subtracting the specified thickness of pavement from the core measurements determined by California Test 531, "Method of Test for Length of Drilled Concrete Cores." Record excess thickness by using a plus sign and deficient thickness by using a minus sign.

4-4003F Calculation of Deductions in Payment to the Contractor for Deficient Thickness

Take these steps when calculating deductions based on deficient thickness:

4-4003F (1) When None of the Primary Cores are Deficient in Thickness by More Than 0.05 Foot

When no primary cores are deficient in thickness by more than 0.05 foot, make an adjustment as follows:

- To determine the average thickness deficiency, if any, for the primary unit, average the thickness variations of all primary cores. Record this value to the nearest 0.01 foot. If the average thickness deficiency is less than 0.01 foot, make no deficiency adjustment. If the average thickness deficiency is more than 0.01 foot, continue with the following steps.
- To obtain the deficiency adjustment in dollars per square yard, use the table in Section 40-1.01D(8)(c)(iv), "Thickness," of the *Standard Specifications*. The average thickness value is to be rounded to the nearest hundredth of a foot for averages from 0.01 foot to 0.05 foot when using the pay adjustment table.
- To obtain the total amount of payment to deduct for the primary unit, multiply the deficiency adjustment by the total area of the primary unit in square yards.

4-4003F (2) When One or More of the Primary Cores are Deficient in Thickness by More Than 0.05 Foot

When one or more cores are deficient in thickness by more than 0.05 foot, determine the limits of the deficiency by taking a secondary core in adjacent panels. Continue taking a secondary core in adjacent panels, expanding as necessary, until the deficient area is bounded by panels with deficient thickness of 0.05 foot or less. The bounded area is referred to as a secondary unit. Reject the secondary unit area for noncompliance pursuant to Section 5-1.30, "Noncompliant and Unauthorized Work," of the *Standard Specifications*. Exclude the secondary unit areas from payment and deduction calculations. In the calculation to determine average thickness of the primary unit, use the average thickness of all secondary cores outside the secondary unit to replace the thickness of the initial primary core within that secondary unit.

To determine the primary unit deduction, multiply the primary unit area, excluding any secondary unit areas, by the appropriate factor, if any, in the table titled "Deduction for Thickness Deficiency" within Section 40-1.01D(8)(c)(iv), "Thickness," of the *Standard Specifications*.

To determine the total deduction, add the deductions for primary units and the cost of all secondary cores, including those taken outside secondary unit areas.

Following is an example illustrating the procedure for measuring the pavement for thickness and calculating deductions for thickness deficiencies. The procedures and the dollar figures used for deductions from payments to the contractor used in the example are based on Section 40-1.01D(8)(c)(iv).

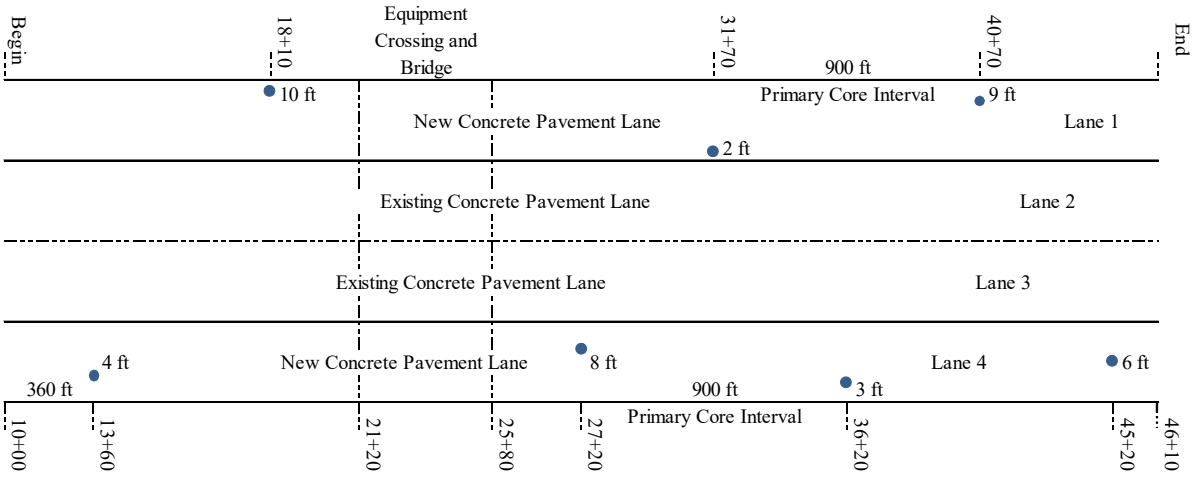
Assume the following:

The contractor paved two lanes (1 and 4) from Station 10+00 to Station 46+10. An equipment crossing and a bridge within the limits of the day's run caused "skips" in the length paved totaling 460 feet (from Station 21+20 to Station 25+80). The actual length paved was 6,300 feet (3,150 feet x 2 lanes). The total area paved on this date was 8,400 square yards.

The engineer calculated the number of cores required for thickness measurements in the primary unit (8,400/1,200 = 7) and the core interval (6,300/7 = 900). To determine the location of the first core, the engineer chose the outside lane, lane 4, at random and used the seventh set of numbers at random, from Table 4-40.10., "Calculation Factors to Locate Cores." The first core was taken at a longitudinal distance of 360 feet from the beginning and at a lateral distance of 4 feet from the right edge of the lane. Subsequent cores were taken at a core interval of 900 feet, excluding skip areas, proceeding from lane 4 to lane 1. Figure 4-40.1., "Primary Cores," illustrates the primary unit and the locations of all the primary cores.

Figure 4-40.1., "Primary Cores," illustrates core thickness variations for the respective numbered cores.

Figure 4-40.1. Primary Cores



a. Length of primary unit = 6300 ft {[(4610-1000) - (2580-2120)]*2}
b. Number of cores = Area/Core Frequency = (6300 ft x 12 ft x 1 sqyd/ 9 sf) / (1200 sqyd/core) = 7 cores
c. Primary core interval = 6300 ft / 7 cores = 900 ft/core
d. Location of the first primary core:
In this example the outside lane (4) is chosen (at random), and the seventh set of numbers (at random) from Table 4-40.1 is used. The first core is taken at a longitudinal distance from the beginning of 360 ft (0.4 x 900 ft). The first core is taken 4 ft from the right edge of the lane.

Core Number	Stationing and Lane	Core Offset	Thickness Variation
1.	Sta. 13+60 Lane 4	4 ft off right edge	-0.03 ft
2.	Sta. 27+20 Lane 4	8 ft off right edge	+0.02 ft
3.	Sta. 36+20 Lane 4	3 ft off right edge	+0.03 ft (use +0.02 ft)
4.	Sta. 45+20 Lane 4	6 ft off right edge	-0.03 ft
5.	Sta. 18+10 Lane 1	10 ft off right edge	-0.04 ft
6.	Sta 31+70 Lane 1	2 ft off right edge	-0.00 ft
7.	Sta 40+70 Lane 1	9 ft off right edge	-0.07 ft

Core 3 is more than 0.02 foot greater than the specified thickness, so + 0.02 foot was used in the calculation to determine thickness deficiency in the primary unit in accordance with Section 40-1.01D(8)(c)(iv), “Thickness,” of the *Standard Specifications*.

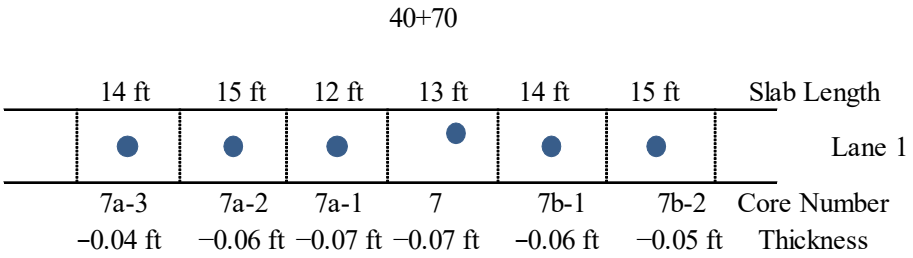
Core 7 was deficient by more than 0.05 foot. Because of this deficiency, the next step was to determine the dimensions of the secondary unit from secondary thickness measurements.

To determine the limits of the secondary unit, the resident engineer ordered secondary thickness measurements in the panels adjacent to the panel where Core 7 was taken. Subsequent thickness measurements were in panels adjacent to panels with thickness deficiencies of more than 0.05 foot. This process continued until the secondary unit was bounded by panels in which the secondary

measurements were deficient in thickness by 0.05 foot or less. Cores in each of these panels were taken in the center of the panel.

Figure 4-40.2, “Secondary Cores,” illustrates the thicknesses of the secondary cores taken.

Figure 4-40.2. Secondary Cores



Core Number	Thickness Variation
7a-1	-0.07 ft
7a-2	-0.06 ft
7a-3	-0.04 ft
7b-1	-0.06 ft
7b-2	-0.05 ft

The panels in the secondary unit area represented by cores 7, 7a-1, 7a-2 and 7b-1 were measured and found to be 54 feet in length and represent 72 square yards.

The engineer averaged thickness variations of the secondary thickness measurements outside the secondary unit area. The resulting value was used in the calculation instead of the thickness variation for Core 7 to determine the average thickness deficiency of the primary unit area. The core thickness variations in the panels surrounding the secondary unit are tabulated in the following table.

Core Number	Thickness Variation
7a-3	-0.4 ft
7b-2	-0.5 ft

The average of the thickness variations in the preceding table is -0.045 feet. This average was rounded to -0.05 foot, and used for the thickness variation for Core 7 in the primary unit.

Using -0.05 foot for the Core 7 thickness deficiency, the engineer calculated the average thickness deficiency (cores 1 through 7) for the primary area to be -0.016

foot. This average was rounded to -0.02 foot and used for the thickness deficiency for the primary unit.

The remaining area of the primary unit, after the area of the secondary unit was subtracted, was as follows:

8,400 - 72 = 8,328 square yards.

The deduction from payment to the contractor for thickness deficiency in the primary area in accordance with Section 40-1.01D(8)(c)(iv), "Thickness," of the *Standard Specifications* was calculated as follows:

8,328 square yards x $2.30 per square yard = $19,154.40

The secondary unit area was later removed, reworked, and replaced. A single core was then taken to determine thickness variation and found to be -0.01 foot. A deduction was then taken on the remedied secondary unit as follows:

72 square yards x $0.90 per square yard = $64.80

In addition to the deductions for pavement thickness deficiencies in the primary and secondary units, a deduction from payment to the contractor was made for the cost of all secondary thickness measurements. The cost of secondary thickness measurements was the cost of cores 7a-1 through 7a-3, 7b-1 through 7b-2, and 7c-1, taken after replacement of secondary unit.

4-4003F (3) Contractor's Requests for Additional Thickness Measurements

If, after the primary coring is performed, the contractor requests additional thickness measurements in any primary unit, treat the request as a request for doubling the frequency of coring in the primary unit area. Locate the additional cores in a manner similar to that used for locating the primary cores. This approach will halve the interval distance between primary cores. To calculate the deficiency adjustment, do not separately consider additional cores that are deficient in thickness by no more than 0.05 foot. Instead, include these cores with the original primary cores. If additional cores are deficient in thickness by more than 0.05 foot, determine the limits of the secondary areas.

Do not grant permission to the contractor for selective coring. However, if the contractor requests additional thickness measurements before the performance of any of the primary coring, you may shorten the length of the coring interval for the primary unit accordingly. For example, the contractor may request a rate of one core for each 600 feet of traffic lane rather than one core for each 900 feet. The request will have the effect of increasing, not necessarily doubling the number of cores.

Deduct from the payment to the contractor the cost of additional thickness measurements that resulted from the contractor's request.

If a contractor requests more than one round of additional cores, consult with the construction field coordinator before granting permission.

4-4003G Handling of Skips in the Original Day's Pour and Secondary Areas to Be Removed and Replaced

Skips, such as gaps left for traffic or equipment crossing, short distances between adjacent bridges, and secondary areas to be removed and replaced, are ultimately poured at a later date. The net area of such pavement placed in any one day technically becomes a primary unit area and, as such, is subject to the specifications regarding thickness measurements. Use judgment regarding which of these areas warrant thickness coring. In general, any area excluded from final coring should be small, and you must have other measurements to confirm that the thickness of the pavement is not deficient.

4-4003H Handling Deficient Areas Not Cored

When you have specific knowledge of areas deficient in thickness and you have records of the extent of such deficiency, exclude these areas from the random coring. Make the deficiency adjustment on the average thickness deficiency in the same manner as for areas that have been cored.

4-4003I Administration

Notify the contractor in writing of the date and place where coring will be performed. Follow up orally, if necessary, to be certain the contractor knows when and where coring will take place.

After measuring and recording pavement thickness, retain the cores until final agreement is reached on payment for the concrete pavement, usually after the contractor returns the proposed final estimate.

The personnel who measure core thickness prepare the coring records, which include information about core location, including sketches, and measured thickness. The original records and 1copy are given to the resident engineer, who retains the original and forwards the copy to the contractor. Personnel from the district materials laboratory will keep one copy; another copy goes to METS in Sacramento.

Separate reports should be prepared and identified for secondary area measurements. These reports will help determine the cost to the contractor for secondary coring and provide a clear record of secondary areas. Follow the same distribution of copies described for primary unit reports.

Coring for determining acceptance of dowel bars and tie bar placement is to be conducted in a similar manner as that of thickness, except for use of revised lot sizes based on the specified frequencies. If dowel or tie bars are placed outside the specified tolerances, or cores show air voids around the bars, obtain additional cores to determine the limits of unacceptable work. Determine the areas that will require removal as specified in Section 40-2.03D, "Correcting Noncompliant Pavement Work," and Section 40-4.03B, "Correcting Noncompliant Pavement Work," of the *Standard Specifications*.

4-4004 Level of Inspection

Suggested levels of field inspection for typical concrete pavement activities are:

- Benchmark inspection of subgrade for compaction and elevation requirements
- Benchmark inspection of forms and paving equipment
- Intermittent inspection of reinforcement, dowel bars, tie bars, dowel bar baskets, and tie bar baskets
- Benchmark inspection of the contractor's early age crack mitigation system for JPCP
- Continuous inspection of concrete delivery, placement, finishing, curing, and contraction joint operations
- Continuous acceptance sampling and testing of fresh concrete
- Intermittent monitoring of the contractor's adherence to their quality control plan
- Benchmark evaluation of pavement for cracking, faulting, spalling, and raveling
- Benchmark inspection of dowel and tie bar placement through coring
- Benchmark inspection of finished surface texture, smoothness, and thickness

4-4005 Quality Control

Guidance for quality control activities included in this section is summarized as follows:

- Review contractor's quality control plan.
- Make sure the contractor submits a copy of the AASHTO accreditation for the laboratory performing the mix design.
- Review control charts, verify that results for quality characteristics are in compliance, and check that copies of control charts are posted at designated location.
- For JPCP, check that the contractor performs quality control methods to properly locate contraction joints, dowel bars, and tie bars.
- For JPCP, review the contractor's early age crack mitigation analysis. As necessary, verify contractor's analysis by performing an independent simulation using high performance concrete paving software.

4-4006 Payment

Using the dimensions shown on the plans, calculate the quantity of concrete pavement to be paid for. Use curve corrections to make sure that calculations account for curves in alignment.

Make deductions from contract payments for deficient pavement thickness.

Chapter 4 Construction Details

Section 41 Existing Concrete Pavement

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4-4102 Before Work Begins
- 4-4102A General
- 4-4102B Pavement Subsealing or Jacking
- 4-4102C Joint Seals
- 4-4102D Dowel Bar Retrofit
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4-4104 Level of Inspection
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Chapter 4 Construction Details

Section 41 Existing Concrete Pavement

4-4101 General

This section provides guidelines for inspecting existing concrete pavement repair for work specified under Section 41, “Existing Concrete Pavement,” of the *Standard Specifications*.

Multiple strategies are used to repair existing concrete pavements. The following common types of concrete pavement repair are covered in this section:

- Pavement subsealing consists of filling voids under the pavement without disturbing the elevation of the finished surface by drilling holes through the pavement and underlying base, cleaning the holes, injecting grout, and filling holes with mortar.
- Pavement jacking consists of filling voids under the pavement and raising the pavement's surface to a desired elevation by drilling holes through the pavement and underlying base, cleaning the holes, injecting grout, and filling holes with mortar.
- Spall repair consists of removing unsound or damaged concrete, filling the area with polyester concrete, and replacing existing joint seals.
- Sealing concrete pavement joints consists of constructing or replacing joint seals at transverse, longitudinal, or isolation joints with silicone, asphalt rubber, or preformed compression joint seal.
- Pavement transition taper may consist of grinding, removing, and replacing existing concrete pavement, or placing temporary hot mix asphalt.
- Dowel bar retrofit consists of placing dowel bars at transverse joints and cracks in existing concrete pavement.
- Individual slab replacement with rapid strength concrete consists of removing the existing concrete pavement and replacing it with rapid strength concrete. Replacing deteriorated underlying base with rapid strength concrete or lean concrete base rapid setting may be required.

The bid item list and plans will specify which concrete pavement repairs are to be performed.

- Additional background information concerning concrete pavement repairs may be found in the *Concrete Pavement Guide* at:

  https://dot.ca.gov/programs/maintenance/pavement/concrete-pavement-and-pavement-foundations

4-4102 Before Work Begins

4-4102A General

Include the following steps in the preliminary review and inspections:

- Verify that the water pollution control plan is authorized.
- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes all materials to be used. Refer to Section 6-202, "Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products," of this manual for additional information.
- Verify that the materials the contractor plans to use comply with Section 41-1.02, "Materials," of the *Standard Specifications*. Where specified, check that the proposed products are on the current Authorized Materials Lists or laboratory test data is submitted.
- Require certificates of compliance for fly ash, admixtures, cement, joint sealant, dowel bars, chemical adhesive, compression seal, backer rods, joint filler materials, and epoxy powder coating.
- Make sure the contractor follows the manufacturer's instructions for materials.
- Inspect packaged fly ash, cement, or combined fly ash and cement to determine that these materials are labeled as required in the specifications. For proper labeling, also collect and review shipping invoices for fly ash and cement delivered in bulk.
- Examine the contractor's equipment to determine that it meets specified requirements.
- Discuss traffic handling with the contractor, and review the contractor's plan for lane closures. Refer to Sections 4-12, "Temporary Traffic Control," and 2-2, "Traffic," of this manual for a discussion of traffic handling devices and lane closure procedures.
- Check the existing condition of the pavement, and note areas to receive concrete repair as needed.
- Check for the presence of traffic loop detectors to prevent damage.
- Verify that the atmospheric and subgrade temperatures are above the specified minimums and that weather conditions are suitable before beginning concrete repairs.

4-4102B Pavement Subsealing or Jacking

- Check the plans for the pattern and location of injection holes.
- Check the contractor's actual layout of injection hole locations to see that it conforms to the planned pattern.
- Establish vertical control for monitoring pavement grades during subsealing or jacking operations.

4-4102C Joint Seals

- Confirm that a training class on joint seals placement techniques is attended by appropriate personnel.
- Inspect that pavement repairs, grinding, and grooving have been completed by the contractor before sealing joint work begins.

4-4102D Dowel Bar Retrofit

- Discuss dowel bar retrofit methods at the preconstruction meeting with personnel who perform the work.
- Verify that a training class on dowel bar placement techniques is attended by appropriate personnel or that the contractor has provided written verification of previous acceptable work experience and training involving dowel bar retrofit of existing concrete pavement.
- Evaluate dowel bar alignment, placement, and concrete consolidation of the required test section to assure conformance with the specification.
- Before slot cutting, survey the existing traffic striping, pavement markings, and pavement markers to determine where delineation repairs will be required.

4-4102E Individual Slab Replacement with Rapid Strength Concrete

For individual slab replacement with rapid strength concrete, do the following:

- Make sure contractor's quality control plan, which details the methods the contractor will use to assure quality of work, is submitted. Review the quality control plan for conformance with the *Standard Specifications* requirements.
- Verify that manufacturer's instructions for storage and installation of specified materials are submitted.
- Verify that samples of cement from each proposed lot and proposed admixtures are submitted.
- Verify submittal of mix design for rapid strength concrete including opening age, aggregate gradations, proportions of constituents, maximum time allowance between batching and placing, range of ambient temperatures over which mix design is effective, final set time, and any special requirements such as water temperature. Note that each mix design has a specified maximum ambient temperature range that may result in multiple mix designs for a single project. Modulus of rupture development data is required for each mix design and must include the following minimum age tests: 1 hour before opening age, opening age, 1 hour after opening age; and 24 hours, 3 days, 7 days, and 28 days after placement.
- Make sure quality control plan and methods of performing each item of the work are discussed with the specified personnel at the preconstruction meeting. Items to be discussed include processes for production, transportation, placement, replacing pavement, protecting the pavement before opening to traffic, contingency plan, sampling, and testing.

- Verify that the contractor successfully constructs trial slabs for each mix design. Assure the contractor is capable of constructing slab replacement in compliance with the specifications within the specified time periods, including delivery, placement, finishing, and curing times, and under similar atmospheric and temperature conditions expected during replacement operations. Additional time for pavement removal, base removal, base replacement, bond breaker, and dowel bar installation as required, must be factored into specified time periods. Trial slabs are not to be placed on the roadway or within the project limits. During trial slab construction, obtain a split sample of aggregate from the contractor for grading, cleanness value, and sand equivalent testing. Check that the contractor fabricates test beams in accordance with specification requirements for determining early age and 3-day modulus of rupture values. Verify the contractor's method for curing beams for early age testing. Verify the contractor's means to monitor and record internal temperatures of trial slabs and early age beams. Reject trial slabs not meeting early age and 3-day modulus of rupture requirements. Require the contractor to dispose of trial slabs.
- Verify that contingency plan equipment, materials, and personnel for temporary roadway pavement are at the job site during individual slab replacement operations.
- For projects with larger individual slab replacement quantities, the special provisions may include requirements covering just-in-time training, materials, construction, and payment. Be sure to review these requirements well in advance of the intended work.

4-4103 During the Course of Work

During the course of the work, do the following for each type of concrete pavement repair strategy:

4-4103A Pavement Subsealing or Jacking

- Verify that the colloidal mixer operates within the specified revolutions per minute.
- Verify that the pump can sustain the specified gauge pressure.
- Verify that the washing device contains the specified number of jets and that the contractor operates it as the specifications require.
- Make sure the contractor performs California Test 541, “Method for Flow of Grout Mixtures (Flow Cone Method),” to check that the efflux time is within the required range during grouting operations.
- Make sure the contractor performs California Test 551, “Method of Test for Suitability of Materials for Overlayment and Repair of Portland Cement Concrete Pavement and Structures,” as specified.
- Monitor the slab for movement during subsealing.

- Monitor the contractor's string lines during jacking to verify slab has been raised to the established grade.
- Monitor grout mixing so that grout not used within the specified time is disposed of properly.
- Check that grinding of noncompliant pavement surface conforms to Section 42, "Groove and Grind Concrete," of the *Standard Specifications*.
- Make sure that removal and replacement of noncompliant pavement conforms to Section 41-9, "Individual Slab Replacement With Rapid Strength Concrete," of the *Standard Specifications*.

4-4103B Spall Repair

- Verify that concrete removal is preceded by sawcutting at the required depth along the rectangular areas to be removed. Make sure that any contractor-damaged concrete outside the designated limits of repair is repaired at the contractor's cost and note these areas and quantities in the daily reports.
- Verify that exposed concrete surfaces are cleaned with equipment conforming to specification requirements.
- Before spall repair material placement, observe joint form board installation and check that any bonding agent is mixed in accordance with manufacturer's instructions and applied to concrete surfaces.
- Verify that spall repair material is mixed, placed, cured, and protected in accordance with specification requirements.
- Make sure removed or damaged joint sealant is repaired at spall locations in accordance with Section 41-5, "Joint Seals," of the *Standard Specifications*.

4-4103C Joint Seals

- Check that removal of existing joint sealant material does not damage the existing sealant reservoir or pavement.
- Where joint sealant reservoirs are constructed, assure concrete residue from sawing operations is collected, contained, and disposed of properly.
- Before backer rod installation, check that sealant reservoir is free of debris, dried, sandblasted, air blasted, and vacuumed in accordance with the specifications.
- Check that backer rod installation does not leave a residue or film on the reservoir walls that will later receive sealant.
- Verify that sealant is prepared and installed in accordance with manufacturer's instructions and specification requirements.
- Before opening to traffic, check that the sealant is tack-free and firm enough to prevent embedding of roadway debris into the sealant.

4-4103D Pavement Transition Taper

- Verify that removal operations do not damage concrete pavement to remain in place and do not create flying debris.
- Verify that grinding concrete pavement complies with Section 42-3, “Grinding,” of the *Standard Specifications*.
- Verify that concrete replacement complies with Section 41-9, “Individual Slab Replacement With Rapid Strength Concrete,” of the *Standard Specifications*.

If placing temporary hot mix asphalt is required, comply with Section 39-2.07, “Minor Hot Mix Asphalt,” of the *Standard Specifications*.

4-4103E Dowel Bar Retrofit

- Check that polyester concrete and joint sealants are stored and installed in accordance with manufacturer’s instructions.
- Verify that saw cut equipment conforms to requirements in the specifications and that saw cuts meet specified tolerances. Verify that concrete debris, water residue, and paste are immediately removed during saw cutting operations.
- Before concrete removal operations, verify that the contractor has sufficient temporary backfill material on hand in accordance with the specifications.
- Make sure concrete removal operations do not damage concrete pavement to remain in place. Verify that contractor’s removal equipment does not exceed the class specified.
- Check that the contractor has scheduled work shifts so removal of concrete for dowel bar slots, placement of dowel bars, and placement of polyester concrete with required cure time will occur before opening to traffic. Use of temporary backfill material is a back-up plan if anticipated production is not achieved. Subsequent work shift operations should be adjusted in consideration of actual production rates.
- Check that dowel bar slots are constructed and cleaned in accordance with specification requirements.
- Verify transverse joints are sealed with caulking filler material meeting specifications.
- Verify that dowel bars are clean before application of dowel bar lubricant. Make sure proper clearance is provided between the dowel bar and pavement surface and placement tolerances are maintained. Verify that expansion caps have been placed on dowel bars and will provide at least the minimum specified joint movement at each end of the bar.
- To assure proper performance of the dowel bars, pay particular attention to the foam core insert, which, when properly installed, helps isolate adjacent slabs. Leakage or displacement of the foam core insert during placement of polyester concrete may damage concrete pavement and shorten design life. Likewise,

dowel bar support chairs must securely hold dowel bars during placement and consolidation of polyester concrete or future problems may arise.

- Verify that polyester concrete is mixed in accordance with manufacturer's instructions. Make sure containers and tools are appropriate for mixing polyester concrete.
- Polyester concrete is to be placed while plastic and immediately consolidated with a small handheld vibrator that thoroughly consolidates the polyester concrete material. Retempering of polyester concrete is not allowed. Finishing tools should be dried thoroughly before use.
- Verify that the polyester concrete is cured under the manufacturer's instructions.
- The contractor grinds concrete pavement under Section 42, "Groove and Grind Concrete," of the *Standard Specifications* within 30 days from the initial saw cutting for the dowel bar slots and at least 12 hours after placing polyester concrete. Grinding is to be performed before any sawing and sealing of joints within the retrofit lanes. Make sure the contractor complies with pavement smoothness and finishing requirements.
- The contractor must perform random cores to verify proper alignment of dowel bars as specified in Section 41-8.03F, "Placing Dowel Bars," of the standard special provisions. If cores indicate dowel bars were installed incorrectly, stop dowel bar retrofit activities until the contractor has demonstrated that the problem causing the improper positioning has been corrected. Check that dowel bars identified as damaged or misaligned are replaced.
- Verify that pavement delineation removed or damaged because of dowel bar retrofit is repaired in accordance with Section 81, "Miscellaneous Traffic Control Devices," and Section 84, "Markings," of the *Standard Specifications*.

4-4103F Individual Slab Replacement With Rapid Strength Concrete

- Verify that contingency plan equipment, materials, and personnel for temporary roadway pavement structure are present at the job site.
- Check that saw cutting is done no more than 2 days before removing pavement. Saw cutting is perpendicular to the travelled way, but the contractor is allowed to saw cut parallel or diagonal to the travelled way if saw cutting and removing pavement is done during the same work shift.
- Before concrete removal, dowel bars and tie bars must be sawn. Make sure the contractor does not affect the surface within 18 inches of the pavement remaining in place.
- Verify that removal of the pavement and base does not damage pavement or base remaining in place. Assure that removed materials are disposed of by the contractor.
- Verify contractor prepares the finished surface of the remaining material in accordance with the specification requirements and to the established grade. Any

over-excavated areas are to be filled with base replacement material, in the same operation as the base replacement, at the contractor's cost.

- Examine base replacement layer to verify it has a smooth surface free of voids, porous areas, and projections such as mortar ridges.
- Before placement of bond breaker, verify that any foreign or loose materials are removed from the base surface. Make sure bond breaker is placed in accordance with specification requirements.
- Verify that installation of dowel bars at transverse construction joints conforms to specification requirements and manufacturer's instructions. Dowel bars must be supported during the chemical adhesive minimum cure time.
- Where rapid strength concrete will be placed against existing concrete, make sure joint filler is placed along the existing transverse and longitudinal joint faces and extending to the full depth, in accordance with the specifications. Depending on existing transverse joint spacing in adjacent lanes, additional transverse contraction joints may require construction as specified.
- Coordinate inspection of rapid strength concrete with plant inspection personnel. Make sure lines of communication are maintained between the plant and the field so contingencies can be used appropriately. Rapid strength concrete must conform to Section 90-3, "Rapid Strength Concrete," of the *Standard Specifications*.
- Spreading, compacting, shaping, and protecting rapid strength concrete must conform to specified requirements.
- Verify that the contractor samples and fabricates beam specimens to determine modulus of rupture at opening age and 3 days, which are used for contract acceptance and payment determination. The modulus of rupture value is determined under California Test 524, "Method of Test for Flexural Strength of Rapid Strength Concrete," by testing 3 beam specimens for each age. No single test represents more than that day's production or 130 cubic yards, whichever is less. Split samples for Caltrans' 3 days modulus of rupture testing.
- Verify that rapid strength concrete surface is finished in accordance with specification requirements.
- Check concrete pavement smoothness using a 12-foot straightedge placed parallel with and perpendicular to the centerline in accordance with the specifications. Verify that the contractor corrects pavement smoothness that is out of compliance.
- When needed, make sure temporary roadway pavement structure is placed, maintained, removed, and disposed of in accordance with specification requirements.

4-4104 Level of Inspection

Suggested levels of inspection for typical existing concrete pavement repair work activities are:

- Benchmark inspection of base.
- Intermittent sampling and testing of concrete pavement repair materials.
- Intermittent review and monitoring of contractor's quality control program including quality control test results.
- Continuous inspection of concrete delivery, placement, finishing, curing, and joint operations.
- Benchmark inspection of pavement smoothness.
- Benchmark inspection of finished surface texture.

4-4105 Quality Control

Guidance for quality control activities included in this section is summarized as follows:

- Make sure the contractor is actively performing quality control on concrete pavement repair materials throughout production operations by reviewing copies of quality control records, including quality control test results.
- The quality control plan must include, but not be limited to:
    - Frequency of quality control sampling and testing that meets or exceeds specification requirements in "Quality Control Testing," of the *Standard Specifications*, as follows:
        - Section 41-2.01D(2), "Quality Control," for subsealing and jacking
        - Section 41-9.01D(2), "Just-in-Time Training," for individual slab replacement with rapid strength concrete
    - Time and frequency of submitting test results.

4-4106 Payment

For measurement and payment, review the plans and quantity calculations in the resident engineer's file to determine if there is sufficient detail and accuracy to be used in the project records. Deduct for any areas that were repaired because of contractor's damage.

For subsealing and jacking, count the number of holes drilled. Verify that the holes to be paid for are only those holes shown on the plans or those ordered to be drilled.

Count bags of packaged fly ash and cement to determine pay quantities for grout by dry weight. During counting, make sure that duplication or omission does not occur. Collect weighmaster certificates for materials delivered in bulk, and remember to deduct quantities of materials wasted or not used. There are no unit price adjustments for an increase and decrease in subsealing and jacking quantity.

For spall repair, payment is measured by the authorized saw cut area. There are no unit price adjustments for an increase and decrease in spall repair quantity.

For sealing concrete pavement joints, measure the actual length of joints installed for seal, replace, or seal and replace concrete pavement joint quantity.

For pavement transition tapers, payment is measured from dimensions shown. No additional compensation is made when temporary hot mix asphalt is used.

For dowel bar retrofit, quantify the number of dowel bar retrofits performed. Do not pay extra for replacing noncompliant dowel bars. Payment for grinding pavement is not included.

For individual slab replacement, payment is based on field measurements. Drill and bond dowel bars and replacing base are not included in payment for individual slab replacement. Specified pay factor adjustments are applicable for low modulus of rupture of rapid strength concrete at 3 days. Rapid strength concrete not meeting the minimum opening age modulus of rupture is to be replaced at the contractor's expense.

Chapter 4 Construction Details

Section 42 Groove and Grind Concrete

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4-4203 During the Course of Work
4-4203A Grooving and Grinding Operations
4-4203B Grooving
4-4203C Grinding
4-4204 Level of Inspection
4-4205 Quality Control
4-4206 Payment

Chapter 4 Construction Details

Section 42 Groove and Grind Concrete

4-4201 General

This section provides guidelines for inspecting groove and grind concrete roadway surfaces for work specified under Section 42, "Groove and Grind Concrete," of the *Standard Specifications*.

The *Concrete Pavement Guide* discusses groove and grind strategies of concrete pavements and is available at:

https://dot.ca.gov/programs/maintenance/pavement/concrete-pavement-and-pavement-foundations

Grooving is usually performed to reduce wet weather accidents on existing concrete pavements or as surface texture correction on new concrete pavements.

Grinding is usually performed to improve the ride quality and texture on existing concrete pavements or for smoothness and surface texture correction on new concrete pavements.

4-4202 Before Work Begins

Include the following in the preliminary review and inspections:

- If the contract specifies inertial profiler measurements, discuss pavement smoothness requirements with the contractor, including existing smoothness information, submittals, and any contractual testing dispute resolution processes. Refer to Section 4-36, "Surfacing and Pavements—General," of this manual for pavement smoothness procedures. Remind the contractor that failure to achieve compliance will require corrective action or removal and replacement, refer to Section 5-1.30, "Noncompliant and Unauthorized Work," of the *Standard Specifications*.
- Discuss traffic handling with the contractor and review the contractor's plan for lane closures. For traffic handling devices and lane closure procedures, refer to Sections 4-12, "Temporary Traffic Control," and 2-2, "Traffic," of this manual.
- Verify that the contractor's equipment meets specified requirements.
- Locate loop detectors to prevent damage to the loop detectors' sealant. If loop detectors are not visible, consult with the district Traffic Unit.
- Check local noise ordinances and review specified noise requirements.
- In areas to be grooved and ground, see if the contract requires yellow stripe and pavement marking removal before grooving and grinding. If yellow striping and marking must be removed before grooving and grinding, refer to Section 7-107E, "Removing Yellow Traffic Stripe and Pavement Markings with Hazardous Waste Residue," of this manual.

- Verify the existence of a water pollution control plan.
- The contract may show locations for on-site drying of concrete grooving and grinding residue before disposal. Verify that temporary storage materials for this purpose conform to WM-8, “Concrete Waste Management,” in the *Construction Site Best Management Practices (BMPs) Manual* or Section 13-9.02, “Materials,” of the *Standard Specifications*.
- The contract or materials information handout may identify locations within the right-of-way for final disposal of concrete grinding and grooving residue. The resident engineer must verify that a Regional Water Quality Control Board permit or approval is included in the materials information handout or resident engineer file. If the permit or approval has not been included, contact your environmental-construction liaison for assistance in obtaining these documents. Refer to the contract special provisions to obtain information about offsite disposal facilities for concrete grooving and grinding residue.
- When the contract documents do not allow final disposal of grooving and grinding residue within the right-of-way, obtain from the contractor the name and location of the disposal facility that will receive the concrete grooving and grinding residues, in accordance with Sections 5-1.20B(4), “Contractor-Property Owner Agreement,” and 13-4.03E(7), “Paving, Sealing, Saw Cutting, Grooving, and Grinding Activities,” of the *Standard Specifications*. Obtain a copy of the facility’s water quality or other applicable agency permit or written approval; or applicable local, state, or federal agency permits for disposal sites outside of California. Also verify the following:
    1. The disposal facility is permitted by the California Environmental Protection Agency (CalEPA) to accept concrete residue. Oral confirmation from the facility operator and documentation in the resident engineer’s daily report are sufficient verification of the permit status of commercial disposal facilities on this list.
    2. The contractor provides a copy of the CalEPA permit for disposal of the liquid concrete residue if choosing the noncommercial offsite disposal facility.
    3. If the disposal site is outside of California, the contractor must provide to the resident engineer a copy of the permit issued by the state agency having jurisdiction over the site. The permit must be provided before disposal.

4-4203 During the Course of Work

During the course of the work, do the following:

4-4203A Grooving and Grinding Operations

The following apply to both grooving and grinding operations:

- Observe the operation to verify that equipment and noise levels comply with specifications.

- Make sure that the handling of residue and dust from the operation meets specifications.
- Verify that the grooved or ground widths meet specifications.
- Make sure that a vacuum device picks up the concrete residue and that the residue does not flow across the pavement or enter storm drain inlets.
- For projects that temporarily store concrete residue in washout facilities, check that the plastic liner seams are installed in accordance with manufacturer requirements. Regularly inspect the liners during installation and operations to verify that they are free of holes, tears, or other defects that will compromise the impermeability of the liner. Inspect washout facilities to make sure that adequate holding capacity and minimum freeboard are maintained.
- When the operation is complete, and offsite disposal is specified, obtain from the contractor final proof of delivery of the residue to the off-site disposal facility.

4-4203B Grooving

When grooving is specified:

- At the beginning of the work shift, check behind the grooving machine to make sure that all the blades are cutting grooves to the specified depth.
- Record the locations of omitted grooves. When specified, require the cutting of omitted grooves.

4-4203C Grinding

When grinding is specified:

- Unless specified otherwise, test for pavement smoothness under Sections 36-3, "Pavement Smoothness," and 40, "Concrete Pavement," of the *Standard Specifications*.
- Determine if any abnormally depressed areas must be excluded from testing with the inertial profiler and the 12-foot straightedge.
- Verify that the inertial profiler uses a minimum 4-inch line laser to obtain profile measurements for concrete pavements.
- Make sure the contractor submits inertial profile information to Concrete.Smoothness@dot.ca.gov in accordance with Section 36-3, "Pavement Smoothness," of the *Standard Specifications*.
- Check that ground areas on structures, approach slabs, and 50 feet of approach pavement meet the smoothness and cover requirements in Section 51-1.01D(3)(b), "Testing Concrete Surfaces," of the *Standard Specifications*.

4-4204 Level of Inspection

Suggested levels of inspection for grooving and grinding activities are:

- Intermittent review of pavement smoothness

- Benchmark review of finished surface texture

4-4205 Quality Control

Check that the contractor is actively performing quality control on pavement smoothness throughout the grinding operations by reviewing inertial profile data.

4-4206 Payment

For measurement and payment, do the following:

- Review the plans and quantity calculations in the resident engineer's file to determine if there is sufficient detail and accuracy to be used in the project records.
- Measure both grooving and grinding by the area grooved or ground. As the work progresses, make transverse measurements to verify that the grooved or ground areas meet the widths specified. You may compute lengths by measuring the distance to start and stop locations from known stations and by computing the length grooved or ground from the stationing. Include curve corrections in the calculations.
- Where grinding has begun on an area that is then replaced by concrete pavement, do not pay for the original grinding area. Instead, measure the area of replaced concrete pavement and pay under the item for grind existing concrete pavement. Do not pay for grinding replacement concrete pavement or for additional grinding to comply with smoothness requirements.
- Refer to Sections 36-3, "Pavement Smoothness," and 40-1, "General," of the *Standard Specifications* for pavement smoothness requirements and payment adjustments, as well as Section 4-4003D, "Post-Paving," of this manual.

Chapter 6 Sampling and Testing

Section 1 Sample Types and Frequencies

6-101 General

6-101A References

6-102 Types of Sampling and Testing

6-102A Preliminary Samples and Tests

6-102B Initial Samples and Tests

Table 6-1.1. Time Required for Source Testing

6-102B (1) Unprocessed Soils and Aggregates

6-102B (1a) Stone from Ledges and Quarries

6-102B (1b) Material Sites of Sand, Gravel, or Soil

6-102B (2) Processed Aggregates

6-102C Acceptance Samples and Tests

Table 6-1.2. Time Required for Materials Acceptance Tests (1 of 4)

Table 6-1.2. Time Required for Materials Acceptance Tests (2 of 4)

Table 6-1.2. Time Required for Materials Acceptance Tests (3 of 4)

Table 6-1.2. Time Required for Materials Acceptance Tests (4 of 4)

Table 6-1.3. Time Required for Products Acceptance Tests

6-102D Dispute Resolution Samples

6-102E Investigation Samples and Tests

6-102F Research Samples and Tests

6-103 Field Sampled Material Identification for Testing

6-103A Forms TL-0101 and TL-0502

Example 6-1.1. Sample Cylinder Label (Set of either five 6- by 12-inch or five 4- by 8-inch cylinders)

Example 6-1.2. Sample Cylinder Label (Set of two 6- by 12-inch cylinders)

Example 6-1.3. Sample Cylinder Label (Set of three 4- by 8-inch cylinders)

6-103B DIME Sample Record

6-104 Shipping of Field Samples

6-105 Acceptance Records

6-106 Project Materials Certification

6-107 Materials Acceptance Sampling and Testing

Table 6-1.4. Materials Acceptance Sampling and Testing Requirements: Earthwork (*Standard Specifications* Section 19) (1 of 3)

Table 6-1.4. Materials Acceptance Sampling and Testing Requirements: Earthwork (*Standard Specifications* Section 19) (2 of 3)

Table 6-1.4. Materials Acceptance Sampling and Testing Requirements: Earthwork (*Standard Specifications* Section 19) (3 of 3)

Table 6-1.5. Materials Acceptance Sampling and Testing Requirements: Stabilized Soils (*Standard Specifications* Section 24) (1 of 3)

Table 6-1.5. Materials Acceptance Sampling and Testing Requirements: Stabilized Soils (*Standard Specifications* Section 24) (2 of 3)
Table 6-1.5. Materials Acceptance Sampling and Testing Requirements: Stabilized Soils (*Standard Specifications* Section 24) (3 of 3)
Table 6-1.6. Materials Acceptance Sampling and Testing Requirements: Aggregate Subbases (*Standard Specifications* Section 25)
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Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (8 of 9)
Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (9 of 9)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (1 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (2 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (3 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (4 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (5 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (6 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (7 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (8 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (9 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (10 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (11 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (12 of 14)
Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (13 of 14)
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Table 6-1.14. Materials Acceptance Sampling and Testing Requirements: Concrete Pavement (*Standard Specifications* Section 40) (2 of 2) See Table 6-1.17. for concrete materials
Table 6-1.15. Materials Acceptance Sampling and Testing Requirements: Existing Concrete Pavement (*Standard Specifications* Section 41)

Table 6-1.16. Materials Acceptance Sampling and Testing Requirements: Concrete Structures (*Standard Specifications* Section 51) See Table 6-1.17. for concrete materials
Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (1 of 9) Concrete, Except Minor Concrete and Rapid Strength Concrete
Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (2 of 9) Concrete, Except Minor Concrete and Rapid Strength Concrete
Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (3 of 9) Concrete, Except Minor Concrete and Rapid Strength Concrete
Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (Standard Specifications Section 90) (4 of 9) Concrete, Except Minor Concrete and Rapid Strength Concrete
Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (5 of 9) Concrete, Except Minor Concrete and Rapid Strength Concrete
Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (6 of 9) Concrete, Except Minor Concrete and Rapid Strength Concrete
Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (7 of 9) Concrete, Except Minor Concrete and Rapid Strength Concrete
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Table 6-1.18. Materials Acceptance Sampling and Testing Requirements: Miscellaneous Materials (2 of 5)
Table 6-1.18. Materials Acceptance Sampling and Testing Requirements: Miscellaneous Materials (3 of 5)
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Chapter 6 Sampling and Testing

Section 1 Sample Types and Frequencies

6-101 General

Sampling and testing materials and products must be in accordance with contract specifications. Sampling and testing are of equal importance for assuring materials and products meet acceptance specifications.

Caltrans representatives must be familiar with materials handling and processing methods to assure representative samples are obtained. Caltrans representatives should be sufficiently knowledgeable about test methods to assure compatibility between sample and test procedure.

Samples for acceptance must be taken in accordance with California Test 125, "Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections," or sampling requirements in specifications. For California Tests, Caltrans representatives must be qualified testers in accordance with the *Independent Assurance Manual.*

It is the resident engineer's responsibility to assure the safety of the Caltrans representative. In accordance with *Material Plant Quality Program* or California Test 109*,* "Method for Testing of Material Production Plants," the district weights and measures coordinator inspects material plants for safety in areas that the Caltrans representative will enter.

In certain situations, to assure the Caltrans representative's safety, the contractor will take acceptance samples for Caltrans. The Caltrans representative must witness the contractor taking acceptance samples. The Caltrans representative must determine when the sample is taken and observe that the sample is taken in accordance with California Test 125, or sampling requirements in specifications. The Caltrans representative must take possession of the sample from the contractor and transport it to a Caltrans office or the testing laboratory. The Caltrans representative must properly fill out form TL-0101 "Sample Identification Card."

The resident engineer is responsible for the chain of custody for material acceptance samples. Material acceptance samples and dispute resolution samples must be in Caltrans' possession from the sampling point. Adequate sample storage facilities must be arranged for at construction field offices or other Caltrans facilities. The chain of custody for material samples is an important part of the Caltrans quality assurance program.

6-101A References

- Independent Assurance Program, Division of Engineering Services, Materials Engineering and Testing Services (METS), Caltrans:

  https://dot.ca.gov/programs/engineering-services/independent-assurance-program

- California Test Methods, METS, Caltrans, available at:

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

- American Association of State Highway and Transportation Officials (AASHTO), American Society for Testing and Materials International (ASTM), and other test methods are available at the IHS Markit website, which can be accessed from the Material Standards (ASTM/AASHTO) link on the Division of Engineering Services' METS webpage.
- *Material Plant Quality Program*, Division of Construction, Caltrans, available at:

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

- DIME, an online web application developed by METS to allow Caltrans staff and contractors to submit material samples and test data for Caltrans projects and programs, is available at:

  https://dime.dot.ca.gov/index.php

6-102 Types of Sampling and Testing

The following are the types of sampling and testing used by Caltrans.

6-102A Preliminary Samples and Tests

Preliminary samples and tests are made before award of a contract. Construction personnel rarely perform preliminary sampling and testing. The district materials engineer is responsible for preliminary sampling and testing. Such tests are used for design purposes, and to provide data for the materials information package for prospective bidders.

6-102B Initial Samples and Tests

Initial samples and tests are performed on materials proposed for use in the project. These initial tests determine whether proposed materials sources, local materials, or products meet the specifications.

Construction personnel may sample potential sources. For soils and aggregate tests, send samples to the district materials laboratory. Caltrans laboratories that perform acceptance tests are not required to be qualified under AASHTO re:source. However, TransLab, the Southern Regional Lab, and district labs that perform JMF verifications are required to be qualified under AASHTO re:source.

Sampling and testing potential local materials is not mandatory unless specified. Charge the contractor for the cost of sampling and testing potential local materials sources in accordance with Section 6, "Control of Materials," of the *Standard Specifications*.

The typical time required for testing initial source samples of potential local materials sources is shown in Table 6-1.1.

Table 6-1.1. Time Required for Source Testing

Material	Time
Aggregates for hot mix asphalt	2 weeks
Aggregates for cement treatment	4 weeks
Aggregates for concrete mixture	4 weeks
Aggregates for concrete pavement	60 days
Screenings for bituminous seals	2 weeks
Soils (R-value)	3 weeks
Untreated base materials	3 weeks

6-102B (1) Unprocessed Soils and Aggregates

The discussion on unprocessed soils and aggregates is primarily applicable to preliminary and initial sampling, although the same precautions apply when sampling for specification compliance.

6-102B (1a) Stone from Ledges and Quarries

Inspect the ledge or quarry face to determine any variations in strata, or in portions of the ledge. Observe and record differences in color and structure. Obtain separate samples of unweathered stone from all strata that appear to vary in color and structure.

6-102B (1b) Material Sites of Sand, Gravel, or Soil

Select samples representing the different materials available in the deposit. If the deposit is worked as an open face or pit, take the samples by channeling the face so that they will represent material that visual inspection indicates may be used. It is necessary, especially in small deposits, to excavate test holes some distance in back of, and parallel to, the face to determine the extent of the supply. The number and depth of these test holes depend on the quantity of material to be used from the deposit. Obtain samples from open test pits by channeling a face of the test pit in the same manner as sampling a face of a materials site. Do not include material in the sample that will be stripped from the pit as overburden. Obtain separate samples from the face of the bank and from the test holes. If visual inspection indicates that there is considerable variation in the material, obtain separate samples at different depths.

Use test holes to sample deposits that have no open faces. When sampling material sites, select depth and spacing of test holes considering the probable method of operating the pit. In general, dozers will combine the material laterally. A shovel will remove the material vertically. Test results in a “spotty” pit may be misleading to the extent that operations may be too expensive to make the required grading.

If possible, use a dozer or shovel to open up the pit before sampling rather than depending on test holes.

6-102B (2) Processed Aggregates

Sample processed aggregates from locations such as stockpiles, transportation units, conveyors, or windrows in accordance with California Test 125, “Method of Test for Sampling Highway Materials and Products Used in the Roadway Pavement Structure Sections.”

6-102C Acceptance Samples and Tests

Acceptance tests are generally performed on materials that will be incorporated into the work. Some acceptance tests are performed on materials already incorporated into the work. Acceptance sampling and testing should begin as soon as the material is delivered or in place.

Sample materials at the locations specified in the *Standard Specifications*, the special provisions, or as required by California Test 125. If the sampling location is not specified, sample at the location indicated in the materials acceptance sampling and testing requirements tables in Section 6-107, “Materials Acceptance Sampling and Testing” of this manual. Regardless of location, sample randomly and within the frequency specified to obtain representative samples of the material used in the work.

On Form TL-0101, “Sample Identification Card,” use the “Priority” designation for the first few acceptance samples of each construction material. Use “Priority” for verification tests for acceptance. Use the “Priority” designation for all samples if the material being supplied is of questionable quality or if the construction means and methods or source of materials changes. For “Priority” tests, indicate if there is a preference for telephoned, faxed, or emailed test results on Form TL-0101, “Sample Identification Card,” along with the telephone number of the person who is to receive them.

For “Priority” and “Normal” processing times for acceptance tests of materials, refer to Table 6-1.2., “Time Required for Materials Acceptance Tests,” of this manual.

The minimum time required for acceptance tests of products is shown in Table 6-1.2., of this manual.

Make sure acceptance samples are shipped or transported to testing laboratories within the following timeframes:

1. Within 1 business day from sampling for projects within 50 miles of the testing laboratory
2. Within 2 business days from sampling for projects more than 50 miles from the testing laboratory

The specified timeframes are not applicable if specific sampling or test method requirements preclude doing so, for example, curing of specimens before transport.

Assure that proper chain of custody is maintained throughout the process, including delivery to and receipt from commercial shipping services.

Use Form CEM-3701, “Test Result Summary,” available in DIME or a paper copy, to summarize acceptance test frequency and test results on each material. Use this form to record sampling and testing related dates and monitor timeliness of acceptance testing. Compare timeliness of material testing turnaround against Table 6-1.2., “Time

Required for Materials Acceptance Tests," and verify that corrective actions are taken and documented if repeated deficiencies are detected.

Notify the contractor of all acceptance test results within 2 business days of receipt from the laboratory. Advise the contractor that that they may opt in to receive automated email notifications of new acceptance tests in DIME. All test results are available for their inspection, and copies of these test results will be made available upon their request. Sample records and verified test results uploaded to DIME are publicly available for viewing. Maintain copies of the test results within the project files or DIME for ready accessibility.

Table 6-1.2. Time Required for Materials Acceptance Tests (1 of 4)

Material and Test	**Sample to Lab** (Note 1) (business days)	**Lab Time Priority** (Note 2) (business days)	**Lab Time Normal** (Note 2) (business days)	**Reporting to Contractor** (Note 3) (business days)	**Total** (business days)
SOILS					
Gradation (CT 202)	1 to 2	1	3	2	4 to 7
Sand Equivalent (CT 217)	1 to 2	1	3	2	4 to 7
Relative Compaction (CT 231/216)	1 to 2	1	2	2	4 to 6
Plasticity Index (Geosynthetic Reinforced Embankment)	1 to 2	3	7	2	6 to 11
pH (Geosynthetic Reinforced Embankment)	1 to 2	2	3	2	5 to 7
Percentage Crushed Particles (Shoulder Backing – CT 205)	1 to 2	2	5	2	5 to 9
Durability Index (Shoulder Backing – CT 229)	1 to 2	2	5	2	5 to 9
R-value (Imported Borrow – CT 301)	1 to 2	4	6	2	7 to 10
SUBBASES AND BASES					
Relative Compaction (CT 231/216)	1 to 2	1	2	2	4 to 6
Gradation (CT 202)	1 to 2	1	3	2	4 to 7
Sand Equivalent (CT 217)	1 to 2	1	3	2	4 to 7
R-value (CT 301)	1 to 2	4	6	2	7 to 10
Durability Index (CT 229)	1 to 2	2	5	2	5 to 9
Compressive Strength (Cement-treated base [CTB] aggregate – CT 312)	-	Age based	Age based	2	Age +2
Compressive Strength (Lean Concrete Base [LCB]–ASTM C39)	-	Age based	Age based	2	Age +2
Compressive Strength (LCB – rapid setting – CT 521)	-	Age based	Age based	2	Age +2
Modulus of Rupture (Concrete base – CT 523)	-	Age based	Age based	2	Age +2
Modulus of Rupture (Rapid strength concrete base – CT 524)	-	Age based	Age based	2	Age +2
Percentage of Crushed Particles (CT 205)	1 to 2	2	5	2	5 to 9
Los Angeles Abrasion Testing (CT 211)	1 to 2	2	4	2	5 to 8
Cleanness Value (CT 227)	1 to 2	2	3	2	5 to 7
Film Stripping (CT 302)	1 to 2	2	7	2	5 to 11
Asphalt Content (ATPB – CT 382)	1 to 2	1	5	2	4 to 9
Soundness (CTPB – CT 214)	1 to 2	8	10	2	11 to 14
SEAL COATS					
Los Angeles Abrasion Testing (CT 211)	1 to 2	2	4	2	5 to 8
Percentage of Crushed Particles (CT 205)	1 to 2	2	5	2	5 to 9
Film Stripping (CT 302)	1 to 2	2	7	2	5 to 11
Gradation (CT 202)	1 to 2	1	3	2	4 to 7

Table 6-1.2. Time Required for Materials Acceptance Tests (2 of 4)

Material and Test	**Sample to Lab** (Note 1) (business days)	**Lab Time Priority** (Note 2) (business days)	**Lab Time Normal** (Note 2) (business days)	**Reporting to Contractor** (Note 3) (business days)	**Total** (business days)
SEAL COATS (Cont.)					
Gradation (ASTM C136)	1 to 2	1	3	2	4 to 7
Cleanness Value (CT 227)	1 to 2	2	3	2	5 to 7
Durability Index (CT 229)	1 to 2	2	5	2	5 to 9
Sand Equivalent (CT 217)	1 to 2	1	3	2	4 to 7
Viscosity (AASHTO T 59)	1 to 2	3	15	2	6 to 19
Viscosity (ASTM D7741)	1 to 2	3	15	2	6 to 19
Viscosity (ASTM D445)	1 to 2	3	15	2	6 to 19
Flash Point (ASTM D92)	1 to 2	3	15	2	6 to 19
Aromatics (ASTM D2007)	1 to 2	7	15	2	10 to 19
Cone Penetration (ASTM D217)	1 to 2	3	15	2	6 to 19
Resilience (ASTM D5329)	1 to 2	3	15	2	6 to 19
Settlement (AASHTO T 59)	1 to 2	7	30	2	10 to 34
Sieve Test (AASHTO T 59)	1 to 2	3	15	2	6 to 19
Demulsibility (AASHTO T 59)	1 to 2	3	15	2	6 to 19
Torsional Recovery (CT 332)	1 to 2	3	15	2	6 to 19
Penetration (AASHTO T 49)	1 to 2	3	15	2	6 to 19
Ring and Ball Softening Point Temperature (AASHTO T 53)	1 to 2	3	15	2	6 to 19
Field Softening Point (ASTM D36)	1 to 2	3	15	2	6 to 19
Elastic Recovery (AASHTO T 301)	1 to 2	4	15	2	7 to 19
Ductility (AASHTO T 51)	1 to 2	4	15	2	7 to 19
Bending Beam Rheometer (AASHTO T 313)	1 to 2	5	8	2	8 to 12
HMA					
Aggregates for HMA					
Gradation (AASHTO T 30)	1 to 2	1	3	2	4 to 7
Asphalt Binder Content (AASHTO T 308, Method A)	1 to 2	2	5	2	5 to 9
Sand Equivalent (AASHTO T 176)	1 to 2	1	3	2	4 to 7
Los Angeles Abrasion Testing (AASHTO T 96)	1 to 2	2	4	2	5 to 8
Percentage of Crushed Particles (Coarse) (AASHTO T 335)	1 to 2	2	5	2	5 to 9
Percentage of Crushed Particles (Fine) (AASHTO T 335)	1 to 2	2	5	2	5 to 9
Flat and Elongated Particles (ASTM D4791)	1 to 2	2	4	2	5 to 8
Fine Aggregate Angularity (AASHTO T 304, Method A)	1 to 2	2	4	2	5 to 8
Asphalt Binder					
Flash Point (AASHTO T 48)	1 to 2	3	15	2	6 to 19

Solubility (AASHTO T 44)	1 to 2	3	15	2	6 to 19
Viscosity (AASHTO T 316)	1 to 2	3	15	2	6 to 19

Table 6-1.2. Time Required for Materials Acceptance Tests (3 of 4)

Material and Test	Sample to Lab (Note 1) (business days)	Lab Time Priority (Note 2) (business days)	Lab Time Normal (Note 2) (business days)	Reporting to Contractor (Note 3) (business days)	Total (business days)
HMA (Cont.)					
Asphalt Binder (Cont.)					
Dynamic Shear – Original Phase (AASHTO T 315)	1 to 2	3	15	2	6 to 19
Dynamic Shear – Rolling Thin Film Oven (RTFO) Phase (AASHTO T 315)	1 to 2	4	15	2	7 to 19
Dynamic Shear – Pressure Aging Vessel (PAV) Phase (AASHTO T 315)	1 to 2	5	15	2	8 to 19
RTFO Test (AASHTO T 240)	1 to 2	3	15	2	6 to 19
Ductility (AASHTO T 51)	1 to 2	3	15	2	6 to 19
Elastic Recovery (AASHTO T 301)	1 to 2	3	15	2	6 to 19
PAV (AASHTO R 28)	1 to 2	4	15	2	7 to 19
Creep and Stiffness (AASHTO T 313)	1 to 2	5	15	2	8 to 19
Binder Recovery (AASHTO T164 / ASTM D1856)	1 to 2	2	15	2	5 to 19
Binder Recovery (AASHTO R 59)	1 to 2	4	15	2	7 to 19
Asphalt Rubber Binder					
Cone Penetration (ASTM D217)	1 to 2	4	15	2	7 to 19
Resilience (ASTM D5329)	1 to 2	4	15	2	7 to 19
Softening Point (ASTM D36)	1 to 2	3	15	2	6 to 19
Viscosity (ASTM D7741)	1 to 2	3	15	2	6 to 19
Asphalt Modifier Properties (ASTM D445, ASTM D92, ASTM D2007)	1 to 2	3	15	2	6 to 19
Crumb Rubber Modifier (CRM) properties (CT 208, CT 385, ASTM D297)	1 to 2	7	30	2	10 to 34
In-Place Hot Mix Asphalt					
Moisture Content (AASHTO T 329)	1 to 2	2	5	2	5 to 9
Asphalt Binder Content (AASHTO T 308, Method A)	1 to 2	2	5	2	5 to 9
Hamburg Wheel Track (AASHTO T 324 [Modified])	1 to 2	7	30	2	10 to 34
Bulk Specific Gravity (AASHTO T 275)	1 to 2	2	7	2	5 to 11
Maximum Theoretical Density (AASHTO T 209)	1 to 2	2	7	2	5 to 11
Field Softening Point (ASTM D36)	1 to 2	3	15	2	6 to 19
Elastic Recovery (AASHTO T 301)	1 to 2	4	15	2	7 to 19
Ductility (AASHTO T 51)	1 to 2	4	15	2	7 to 19
Bending Beam Rheometer (AASHTO T 313)	1 to 2	5	8	2	8 to 12

Table 6-1.2. Time Required for Materials Acceptance Tests (4 of 4)

Material and Test	Sample to Lab (Note 1) (business days)	Lab Time Priority (Note 2) (business days)	Lab Time Normal (Note 2) (business days)	Reporting to Contractor (Note 3) (business days)	Total (business days)
CONCRETE PAVEMENT					
Los Angeles Abrasion Testing (CT 211)	1 to 2	2	4	2	5 to 8
Cleanness Value (CT 227)	1 to 2	2	3	2	5 to 7
Gradation (CT 202)	1 to 2	1	3	2	4 to 7
Sand Equivalent (CT 217)	1 to 2	1	3	2	4 to 7
Modulus of Rupture (CT 523)	-	Age based	Age based	2	Age +2
Thickness (CT 531)	2	2	7	2	6 to 11
Dowel bar alignment and concrete consolidation	2	2	5	2	6 to 9
Tie bar alignment and concrete consolidation	2	2	5	2	6 to 9
Inertial Profiler (AASHTO R 56 & R 57)	7 (See Note 4)	3	7	2	12 to 16
CONCRETE STRUCTURES					
Los Angeles Abrasion Testing (CT 211)	1 to 2	2	4	2	5 to 8
Cleanness Value (CT 227)	1 to 2	2	3	2	5 to 7
Gradation (CT 202)	1 to 2	1	3	2	4 to 7
Sand Equivalent (CT 217)	1 to 2	1	3	2	4 to 7
Compressive Strength (CT 521)	-	Age based	Age based	2	Age +2
CONCRETE					
Gradation (CT 202)	1 to 2	1	3	2	4 to 7
Cement (Various)	1 to 2	35	60	2	38 to 64
Supplementary Cementitious Materials (Various)	1 to 2	35	60	2	38 to 64
Shrinkage (AASHTO T 160)	1 to 2	42	60	2	45 to 64

Notes:

1. Time to testing laboratory begins from time of sampling and includes any required field curing time and time required for transport to the testing laboratory.
2. Time in laboratory begins from time laboratory receives the sample and includes any required laboratory curing time before testing and time required to prioritize samples. This time also includes the lab manager's review of test results and the time to notify the resident engineer.
3. Reporting time begins when the test is provided to the resident engineer and ends when the contractor is notified of the test results.
4. Days to schedule lab for testing

Table 6-1.3. Time Required for Products Acceptance Tests

Product	Minimum Time (Business Days)
Coating tests	3
Expansion joint material	3
Fencing, all types	2
Guide posts	3
Geosynthetic fabrics	3
Geosynthetic fabrics, UV testing	45
Metal guardrail	7
Pavement markers	4
Prestressing steel	10
Reinforcing steel and wire	2
Rubber accompanied by manufacturer test report	3
Rubber without test report	14
Structural steel	10
Type B joint seal	7

6-102D Dispute Resolution Samples

Code of Federal Regulations, Title 23, Section 637.207 (23 CFR 637.207), "Quality Assurance Program," paragraph (a)(1)(iii), states, "If the results from the quality control sampling and testing are used in the acceptance program, the STD (state transportation department) shall establish a dispute resolution system. The dispute resolution system shall address the resolution of discrepancies occurring between the verification sampling and testing and the quality control sampling and testing." When specified, the engineer must split acceptance test samples and store the split samples in case of a disputed test result. Caltrans requires split samples to be stored in a facility under state control in case they are needed for dispute resolution.

6-102E Investigation Samples and Tests

Specific materials or quality problems such as pavement failures, difficulty in achieving percent of maximum theoretical density, or inconsistent test results may require special samples and tests. When materials problems are encountered, contact the district materials engineer. The district materials engineer may request help from METS and the Division of Construction. METS will request all acceptance test results and contractor quality control test results along with material-specific additional samples and tests in order to conduct a forensic investigation.

6-102F Research Samples and Tests

Pilot projects usually have special requirements for sampling and testing of materials.

Projects developed around research needs usually require larger samples and more frequent testing than what is required by Caltrans' acceptance testing minimum

frequencies. The unit that requested the research project will provide oversight for all of the special sampling and testing requirements.

6-103 Field Sampled Material Identification for Testing

Samples must be properly identified so the testing laboratory can function efficiently and report results to the project in a timely manner. In addition, accuracy in identifying where the material was placed in the project can be very useful if the material must be rejected by the engineer and then removed by the contractor.

One method for submitting sample identification information uses Form TL-0101 and TL-0502. Creating a DIME sample record online is an alternative approach to Form TL-0101 and TL-0502. DIME is a web application designed to collect and store material sample and testing information on California transportation projects.

6-103A Forms TL-0101 and TL-0502

For requesting faster processing of samples, use the “Priority” designation as discussed in Section 6-102C, “Acceptance Samples and Tests,” of this manual.

For field material samples, except for concrete cylinder compressive strength, use Form TL-0101, “Sample Identification Card,” or create a DIME sample record. For concrete cylinder compressive strength, use Form TL-0502, “Field Sample of Portland Cement Concrete Sample Card,” or create a DIME sample record.

Form TL-0101 can be generated by DIME after creating a DIME sample record. In general, prepare Form TL-0101 as follows:

- Fill in every blank space with complete information, including the quantity and lot of material sampled.
- The “Location of Source” must clearly indicate the place, behind paver, stockpile, or cold feed belt, where the sample was taken.
- Indicate “Normal” for laboratory processing of sample or “Priority” if a test result is needed quickly.
- If the sample was taken at the request of the contractor from local deposits as a potential source in accordance with Section 6-1.03, “Local Materials,” of the *Standard Specifications,* note this under “Remarks.” Request that the district materials laboratory provides the cost of testing so that Caltrans can be reimbursed by the contractor.
- To protect the sample identification card against moisture or stains, place it in a plastic bag or shipping label protector and tape it to the sample container.
- Distribute copies as shown on the form on the same day the sample is shipped.
- Prepare Form TL-0101 in accordance with the following details based on the type of material:
    - Aggregate sources must be in compliance with or not subject to the State Mining and Reclamation Act (SMARA). Verify that sources of aggregates are indicated and include the SMARA listing number. For additional information,

refer to Section 7-103H (2), “Surface Mining and Reclamation Act,” of this manual.

- For hot mix asphalt (HMA) sample be sure to:
  1. Identify the HMA plant producing the material.
  2. Identify the job mix formula (JMF) producer identification number.
  3. Include the type of mix and aggregate grading specified.
  4. Under “Remarks,” include the grade and source of the asphalt binder.
  5. Under “Remarks,” include the percentage of asphalt binder designated in the JMF.
- For asphalt binder sample be sure to:
  1. Identify the HMA plant using the material.
  2. Identify the source of asphalt binder.

  A list of approved asphalt suppliers is available at:

  https://mets.dot.ca.gov/aml/AsphaltBindersList.php
- For nonapproved suppliers, identify the refinery and shipment number for each truckload.
- For tack coat or asphalt emulsion samples, be sure to:
  1. Identify the source of the asphalt binder or asphaltic emulsion.
  2. Under “Remarks” include the dilution rate (50/50 or 60/40) for asphaltic emulsions or enter “Not Diluted.”
- If the specification has requirements based on the use of the material, include the intended use under “Remarks.” This is especially important for electrical conductors, because the applicable specifications depend on where and how the conductor is used.

- Prepare Form TL-0502, “Field Sample of Portland Cement Concrete Sample Card,” for each set of two cylinders, set of three cylinders, or set of five cylinders shipped as follows:
  - Fill in every blank space with complete information.
  - Indicate sources of aggregates and include the SMARA listing number. Aggregate sources must be in compliance with or not subject to SMARA. For additional information, refer to Section 7-103H (2), “Surface Mining and Reclamation Act,” of this manual. Indicate in the space for water the total weight of water used per cubic yard of cementitious material in the mix based on actual weight, not design weight.
  - Under “Remarks,” indicate the specified concrete strength.
  - Under “Remarks,” indicate if the unit weight of the hardened concrete cylinders is required. The testing laboratory will not furnish unit weight data unless it is specifically requested.

- To protect the sample card against moisture or stains, place it in a plastic bag or shipping label protector, and tape it to the sample container.
- Distribute copies as shown on the form on the same day the sample is shipped.

A uniform system for marking cylinders is used. This system consists of the contract number and the sample number. The sample number consists of a series of digits separated by dashes (-) to indicate: method of storage for curing; age at which cylinders are to be tested; the cylinder number of the set of two, set of three, or set of five, that is to be tested; and project coding. Use a flow pen or permanent marker to mark the cylinders.

Following are examples of the cylinder marking system.

Example 6-1.1. Sample Cylinder Label (Set of either five 6- by 12-inch or five 4- by 8-inch cylinders)

Contract No. 03-100844

Sample No. 1-28-1/5_ _ _ _ _

Date Cast _____

Structure ID: 59-5629L

For sample shown in Example 6-1.1., (Set of either five 6- by 12-inch or five 4- by 8-inch cylinders):

- The first digit indicates method 1 storage for curing.
- The second two digits indicate that the cylinder is to be tested at 28 days.
- The 1/5 set indicates that it is the No. 1 cylinder of 5 cylinders. The No. 2 cylinder would be marked 2/5, and so on, for the remaining cylinders of the group.
- The last four spaces are reserved for any project coding consisting of numbers, letters, or a combination.

Note if only one sample card was made for five cylinders, the third symbol on the card would be 1,2,3,4,5/5.

Example 6-1.2. Sample Cylinder Label (Set of two 6- by 12-inch cylinders)

Contract No. 03-100844

Sample No. 2-14-2/2_ _ _ _

Date Cast _____

Structure ID: 59-5629L

For sample shown in Example 6-1.2., (Set of two 6- by 12-inch cylinders):

- The first digit indicates method 2 storage for curing.
- The second two digits indicate that the cylinder is to be tested at 14 days.
- The 2/2 set indicates that it is the No. 2 cylinder of a group of 2 cylinders.
- The last four spaces are reserved for any project coding consisting of numbers, letters or a combination.

Note if one sample card is made for the two cylinders, the third symbol on the card would be 1,2/2.

Example 6-1.3. Sample Cylinder Label (Set of three 4- by 8-inch cylinders)

Contract No. 03-100844

Sample No. 2-07-3/3_ _ _ _

Date Cast _____

Structure ID: 59-5629L

For sample shown in Example 6-1.3., (Set of three 4- by 8-inch cylinders)

• The first digit indicates method 2 storage for curing.

• The second two digits indicate that the cylinder is to be tested at 7 days.

• The 3/3 set indicates that it is the No. 3 cylinder of a group of 3 cylinders.

• The last four spaces are reserved for any project coding consisting of numbers, letters or a combination.

Note if one sample card is made for the three cylinders, the third symbol on the card would be 1,2,3/3.

6-103B DIME Sample Record

METS allows Caltrans staff to submit sample information and test data using DIME.

A DIME account is needed to submit and view test result information. For a complete overview of how to access DIME, submit sample information, provide test results, and learn about DIME features, go to DIME Instructions, available at:

https://dime.dot.ca.gov/index.php?r=site/instructions

Prepare a DIME sample record as follows:

- Log in to DIME.
- Click on the “New Sample” link from the secondary menu panel. You will be presented with a form for creating a new DIME sample record. You must fill out all of the required fields.
- Enter the Caltrans project identification number associated with the material sample.
- Fill in all the fields applicable to the material sample with complete information in both the Sample and Material Identification section.
- Fill in the optional fields applicable to the material sample and provide additional notes if needed.
- Verify that the sample record information is filled out completely and correctly.
- Click on the “Create Sample” button to create the sample record and a DIME Sample ID will be generated.

6-104 Shipping of Field Samples

The material sampler makes sure the DIME Sample ID or Forms TL-0101 or TL-0502 accompanies the material sample when it is shipped from the job site to the testing laboratory. Testing laboratories will use the DIME Sample ID to submit test results for the sample.

Based on turnaround time needed to receive a test result, ship samples from the job site to the laboratory using the most economical mode of transportation available consistent with the time element involved. Do not accumulate samples at the project site to save transportation costs.

Concrete cylinders are shipped to the laboratory in accordance with California Test 540, “Method of Test for Making and Curing Concrete Test Specimens in the Field.” Cylinders are shipped without removing the mold and are packed in cardboard containers available at the district warehouse.

If the district laboratory is equipped to test concrete cylinders, they should be shipped there. Otherwise, cylinders may be delivered either to the Southern Regional Lab at 13970 Victoria Street, Fontana, CA 92336, or METS at 5900 Folsom Boulevard, Sacramento, CA 95819, whichever is more convenient. Ship concrete cylinders within the time limits specified in California Test 540 or the test result cannot be used as an acceptance test.

Shipping costs to district materials laboratories, the Southern Regional Lab, or METS, are to be prepaid.

6-105 Acceptance Records

Keep records of all samples and tests in the project files as permanent job records. DIME can be used as Caltrans laboratory management tool to efficiently store material sample and test data for California transportation projects. Monitor acceptance testing frequency, results, and timelines by using Form CEM-3701, “Test Result Summary,” available in DIME or a paper copy. Corrective action or retesting of failing tests must be noted in the “Remarks” column of the form.

Documentation of the reason materials represented by failing tests were incorporated into the project must be included in the project files. For more information on procedures to follow in the case of failing tests, refer to Section 3-6, “Control of Materials,” of this manual.

It is not necessary to secure separate samples for each project when two or more projects receive materials from the same source. File a copy of the test report with each project.

6-106 Project Materials Certification

When construction work on the project is complete, prepare Form CEM-6302, “Final Materials Certification.” Use the form to certify that, other than for the exceptions listed on the form, the results of tests performed on acceptance samples show that the materials used in the work controlled by sampling and testing conform to the approved plans and specifications.

If exceptions exist, check the exceptions box and note all nonconforming materials on the form. The following are examples of nonconforming materials that must be noted as exceptions:

- Materials accepted by applying a specified pay factor or deficiency adjustment, such as for hot mix asphalt, concrete pavement, or rapid-strength concrete.
- Materials out of "operating range" but within "contract compliance" for which a specified payment deduction was made.
- Materials not in compliance with the as-bid contract plans or specifications for which a change order was approved to accept the material.
- Materials that require certificates of compliance but one or more have not been submitted.

Sign the form and put the original in the project files. Send a copy to district Construction and, if the project is subject to Federal Highway Administration (FHWA) construction oversight activities, send a copy to the FHWA California division administrator. The name and address of the FHWA California division administrator is available at:

https://www.fhwa.dot.gov/cadiv/directory.cfm

6-107 Materials Acceptance Sampling and Testing

Sampling and testing materials and products must be in accordance with contract specifications. Sampling and testing are of equal importance for assuring materials and products meet acceptance specifications.

The tables that make up Table 6-1.4., "Materials Acceptance Sampling and Testing Requirements," contain Caltrans' minimum sampling and testing requirements for materials acceptance. The frequency of sampling and testing indicated in the tables is to be used under normal conditions. Materials that are marginal in meeting the specifications should be sampled and tested on a more frequent basis. Request "Priority" testing for samples taken on potentially marginal materials.

When shown in the tables that testing frequencies may be adjusted, document any adjustment in a "Memo to File." Place the "Memo to File" in the appropriate part of Category 37, "Initial Tests and Acceptance Tests," of the project files.

Adherence to the sample size requirements shown in the tables will prevent unnecessary delays and expense of obtaining supplementary samples to complete tests.

Refer to Section 6-105, "Acceptance Records," of this manual for documenting acceptance tests results. For more information on procedures to follow in the case of failing tests, refer to Section 3-6, "Control of Materials," of this manual.

Table 6-1.4. Materials Acceptance Sampling and Testing Requirements: Earthwork (*Standard Specifications* Section 19) (1 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
STRUCTURE BACKFILL (Section 19-3.02C)					
Sieve Analysis	California Test 202	50 lb	Materials site or stockpile	1 every 3,000 tons or 2,000 cu yd	If uniform material is within specification limits, test frequency may be decreased to 1 per day
Sand Equivalent	California Test 217	50 lb	Materials site or stockpile	1 every 3,000 tons or 2,000 cu yd	If uniform material is within specification limits, test frequency may be decreased to 1 per day
Relative Compaction	California Test 231	Sample for California Test 216	Project site in accordance with California Test 231	1 every 2,000 sq yd and test compaction at every 8 in. of thickness	Relative compaction test is required at each location structure backfill is placed
Maximum Wet Density	California Test 216	35 lb	Relative compaction test site locations	1 every relative compaction test	Wet common-composite test maximum value may be used in accordance with California Test 231
PERVIOUS BACKFILL MATERIAL (Section 19-3.02D)					
Sieve Analysis	California Test 202	50 lb	Stockpile	1 every 3,000 tons or 2,000 cu yd	If uniform material is within specification limits, test frequency may be decreased to 1 per day
COMPACTION (Section 19-5)					
R-Value	California Test 301	50 lb	Project site	Test to verify R-value if differing site conditions are encountered	If R-value testing in the materials report is incomplete because of preproject conditions, then test to verify design R-value
Relative Compaction	California Test 231	Sample for California Test 216	California Test 216	1 every 2,000 sq yd	
Maximum Wet Density	California Test 216	35 lb	Relative compaction test site locations	1 every relative compaction test	

Table 6-1.4. Materials Acceptance Sampling and Testing Requirements: Earthwork (*Standard Specifications* Section 19) (2 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (See Note 1)	Acceptance Test Frequency	Remarks
EMBANKMENT CONSTRUCTION (Section 19-6)					
Relative Compaction	California Test 231	Sample for California Test 216	Project site in accordance with California Test 231	1 every 2,000 sq yd and test compaction at every 8 in. of thickness	
Maximum Wet Density	California Test 216	35 lb	Relative compaction test site locations	1 every relative compaction test	Wet common-composite test maximum value may be used in accordance with California Test 231
GEOSYNTHETIC REINFORCED EMBANKMENT (Section 19-6.02B)					
Plasticity Index	California Test 204	50 lb	Materials site or stockpile	1 per source before use	
pH	California Test 643	50 lb	Materials site or stockpile	1 per source before use	
Sieve Analysis	California Test 202	50 lb	Stockpile	Before use, 1 every 3,000 tons or 2,000 cu yd	If material is uniform and well within specification limits, the test frequency may be decreased to 1 per day
BORROW MATERIAL (Section 19-7)					
R-Value	California Test 301	50 lb	Import borrow source	1 per source	Test for R-value only when an R-value is specified for import borrow in the special provisions; if material at import borrow source is not uniform, increase testing frequency

Table 6-1.4. Materials Acceptance Sampling and Testing Requirements: Earthwork (*Standard Specifications* Section 19) (3 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
SHOULDER BACKING (Section 19-9)					
Crushed Particles	California Test 205	50 lb	Materials site or stockpile	1 per project before use	
Durability	California Test 229	50 lb	Materials site or stockpile	1 per project before use	
Unit Weight	California Test 212 Rodding Method	50 lb	Materials site or stockpile	1 per project before use	
Sieve Analysis	California Test 202	50 lb	Materials site or stockpile	1 every 3,000 tons or 2,000 cu yd	If uniform material is within specification limits, test frequency may be decreased to 1 per day
Sand Equivalent	California Test 217	50 lb	Materials site or stockpile	1 every 3,000 tons or 2,000 cu yd	If uniform material is within specification limits, test frequency may be decreased to 1 per day

Note:

1. Refer to California Test 125 for sampling procedures.

Table 6-1.5. Materials Acceptance Sampling and Testing Requirements: Stabilized Soils (*Standard Specifications* Section 24) (1 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
LIME (Section 24-2.02)					
Various properties	See *Standard Specifications* Section 24-2.02	One 10-lb sample for each type and source of lime; use a 2-qt airtight container	Initial sample provided by contractor; subsequent sampling from mid-point of delivery	Each 100 tons of lime, 2 per day maximum	Must be on an Authorized Materials List and certificate of compliance must accompany each shipment; recommend 1 acceptance test per 5 samples of lime
LIME TREATMENT					
DETERMINATION OF LIME APPLICATION RATE (Section 24-2.01D)					
Unconfined Compressive Strength	California Test 373	100 lb	Native soils; test each type of material to be treated	Before soil stabilization work and if source of lime changes	To determine appropriate lime content
Optimum Moisture Content	California Test 373	100 lb	Native soils; test each type of material to be treated	Before soil stabilization work	
VERIFICATION OF LIME APPLICATION RATE AND STABILIZED SOIL MIXTURE (Section 24-2.01D)					
Lime Application (Dry Form)	Calibrated tray method or equal	Building paper or pan of known area	Surface receiving lime	Each 40,000 sq ft, 2 per day minimum	To determine if application rate is within ± 5% of ordered application rate
Lime Application (Slurry Form)	Volumetric measurement that is then reduced to lime weight	Deter-mined over known area	Slurry holding tank	Each 40,000 sq ft, 2 per day minimum	To determine if application rate is within ± 5% of ordered application rate
Uniformity of Mixed Stabilized Soil	Phenolphthalein alcohol indicator solution spray	N/A	Representative areas	Each day at five separate locations	Taken after completion of initial mixing

Table 6-1.5. Materials Acceptance Sampling and Testing Requirements: Stabilized Soils (*Standard Specifications* Section 24) (2 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
VERIFICATION OF LIME APPLICATION RATE AND STABILIZED SOIL MIXTURE (Section 24-2.01D)					
Moisture Content of Mixed Stabilized Soil	California Test 226	0.25 lb each sample	Representa-tive areas at mid depth	Each day at five separate locations to verify contractor's quality control tests	Taken during mellowing period
Gradation of Mixed Stabilized Soil	California Test 202	25 lb	Representa-tive areas	1 every 4,000 sq yd, 1 per day minimum	Taken before compaction
MIXED STABILIZED SOIL (Sections 24-2.01 and 24-2.03)					
Relative Compaction	California Test 231	Sample for California Test 216	Project site in accordance with California Test 231	1 every 2,000 sq yd and test compaction at every 6 in. of thickness	
Maximum Wet Density	California Test 216	35 lb	Relative compaction test site locations	1 every relative compaction test	Wet common-composite test maximum value may be used in accordance with California Test 231
Dimensions	Measurement	N/A	Random locations in place after compaction	As necessary for verification of stabilized soil thickness and surface grades	

Table 6-1.5. Materials Acceptance Sampling and Testing Requirements: Stabilized Soils (*Standard Specifications* Section 24) (3 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CURING SEAL-ASPHALTIC EMULSION (Section 24-1.02C)					
Various properties based on asphaltic emulsion type used	Based on asphaltic emulsion type used; see *Standard Specifications* Section 94	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Sampling line leading to the spray bar	1 each shipment	Each shipment must be accompanied by a certificate of compliance; recommend 1 random test from samples taken

Note:

1. Refer to California Test 125 for sampling procedures.

Table 6-1.6. Materials Acceptance Sampling and Testing Requirements: Aggregate Subbases (*Standard Specifications* Section 25)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
AGGREGATE SUBBASE					
Gradation (Sieve Analysis)	California Test 202	50 lb	Windrow or roadway	Every 3,000 tons or 2,000 cu yd (See Note 2)	If uniform material is within specification limits, frequency may be decreased to 1 test per day
Sand Equivalent	California Test 217	50 lb	Windrow or roadway	Every 3,000 tons or 2,000 cu yd (See Note 2)	If uniform material within specification limits, frequency may be decreased to 1 test per day
R-Value	California Test 301	50 lb	Windrow or roadway	Every 3,000 tons or 2,000 cu yd	R-value testing may be reduced to 1 acceptance test per project when test records demonstrate that comparable material from the same source meets minimum R-value requirements
Relative Compaction	California Test 231	Sample for California Test 216	Roadway in accordance with California Test 231	Every 2,000 sq yd	
Maximum Wet Density	California Test 216	35 lb	Relative compaction test site locations	Every 2,000 sq yd	Wet common-composite test maximum value may be used in accordance with California Test 231
Dimensions	N/A	N/A	Random locations	As necessary for acceptance	Verify thickness of aggregate subbase

Notes:

1. Refer to California Test 125 for sampling procedures.
2. If material is outside the specification limits, sample and test representative material every 500 cu yd so that deductions may be taken for noncompliant material.

Table 6-1.7. Materials Acceptance Sampling and Testing Requirements: Aggregate Bases (*Standard Specifications* Section 26)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
AGGREGATE BASES					
Gradation (Sieve Analysis)	California Test 202	50 lb	Windrow or roadway	Every 3,000 tons or 2,000 cu yd (See Note 2)	If uniform material is within specification limits, frequency may be decreased to 1 test per day
Sand Equivalent	California Test 217	50 lb	Windrow or roadway	Every 3,000 tons or 2,000 cu yd (See Note 2)	If uniform material is within specification limits, frequency may be decreased to 1 test per day
Resistance Value (R-Value)	California Test 301	50 lb	Windrow or roadway	Every 3,000 tons or 2,000 cu yd	R-value testing may reduced to 1 acceptance test per project when test records demonstrate that comparable material from the same source meets minimum R-value requirements
Durability Index	California Test 229	50 lb	Windrow or roadway	1 per project	Durability test not required for Class 3 aggregate base
Moisture	California Test 226	25 lb	Materials site or stockpile	2 daily when aggregate base is paid for by weight	
Relative Compaction	California Test 231	Sample for California Test 216	Roadway in accordance with California Test 231	Every 2,000 sq yd	
Maximum Wet Density	California Test 216	35 lb	Relative compaction test site locations	Every 2,000 sq yd	Wet common-composite test maximum value may be used in accordance with California Test 231
Dimensions	N/A	N/A	Random locations	As necessary for acceptance	Verify thickness of aggregate base

Notes:
1. Refer to California Test 125 for sampling procedures.
2. If material is outside the specification limits, sample and test representative material every 500 cu yd so that deductions may be taken for noncompliant material.

Table 6-1.8. Materials Acceptance Sampling and Testing Requirements: Cement Treated Bases (*Standard Specifications* Section 27) (1 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CEMENT TREATED BASE Class A or Class B					
AGGREGATE					
Gradation (Sieve Analysis)	California Test 202, California Test 105	40 lb	Plant, truck, windrow, or roadway	1 every 3,000 tons or 2,000 cu yd, minimum 1 per day of production	
Sand Equivalent	California Test 217	40 lb	Plant, truck, windrow, or roadway	1 every 3,000 tons or 2,000 cu yd, minimum 1 per day of production	
AGGREGATE Class B					
R-Value (with and without cement)	California Test 301	100 lb for aggregate qualifica-tion	Windrow or roadway	Before production	
CEMENT Type II Portland Cement					
Various properties must comply with *Standard Specifications* Section 90-1.02B(2)	See *Standard Specifications* Section 90-1.02B(2)	8 lb	Cement treated base plant or cement spreader	1 each 100 tons of cement, 2 per day maximum	Recommend 1 acceptance test per project for cement from approved suppliers and certificate of compliance with each shipment
WATER					
Chlorides	California Test 422	Clean 2-qt plastic jug with lined, sealed lid	1 per source; at point of use		Water supplies for domestic use do not need to be tested

Table 6-1.8. Materials Acceptance Sampling and Testing Requirements: Cement Treated Bases (*Standard Specifications* Section 27) (2 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
WATER (Cont.)					
Sulfates	California Test 417	Clean 2-qt plastic jug with lined, sealed lid	1 per source; at point of use		Water supplies for domestic use do not need to be tested
COMPLETED MIX Class A					
Compressive Strength	California Test 312	See California Test 312, Part II	Windrow or roadway before compaction	1 per day	If first 3 days of production test records demonstrate materials are in compliance, recommend test every 5 days of production
COMPLETED MIX Class B					
R-Value	California Test 301	50 lb	Windrow or roadway before compaction	1 every 3,000 tons or 2,000 cu yd	Recommend R-value testing be reduced to 1 every 10,000 cu yd when test records demonstrate that material from the same source, and having comparable grading and sand equivalent values, meets the minimum R-value requirements

Table 6-1.8. Materials Acceptance Sampling and Testing Requirements: Cement Treated Bases (*Standard Specifications* Section 27) (3 of 3)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
COMPLETED MIX Class A and Class B					
Cement Content	California Test 338	See California Test 338, Part I	Windrow or roadway before compaction	1 every 1,500 tons or 1,000 cu yd, minimum 1 per day of production	
Optimum Moisture	California Test 312	See California Test 312	Windrow or roadway	Before production	
Moisture Content	California Test 226	10 lb in sealed container	Roadway before compaction	2 daily	
Relative Compaction	California Test 312 or 231	Sample for California Test 216	Roadway in accordance with California Test 231	1 every 2,000 sq yd	
Maximum Wet Density	California Test 216, California Test 312	35 lb	Relative compaction test site locations	1 every 2,000 sq yd	Wet common-composite test maximum value may be used in accordance with California Test 231
Dimensions	N/A	N/A	Random locations	As necessary for acceptance	Verify thickness of cement treated base

Note:

1. Refer to California Test 125 for sampling procedures.

Table 6-1.9. Materials Acceptance Sampling and Testing Requirements:
Concrete Bases (*Standard Specifications* Section 28)
Lean Concrete Base

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
LEAN CONCRETE BASES					
Compressive strength (7-days)	ASTM C39	6 cylinders 6x12 in. - 3 tests	Concrete truck discharge chute	1,000 cu yd or 1 day's production if less than 1,000 cu yd	
Compressive strength (3-days)	ASTM C39	6 cylinders 6x12 in. - 3 tests	Concrete truck discharge chute	1,000 cu yd or 1 day's production if less than 1,000 cu yd	Optional test to qualify for a transverse contraction joint waiver
RAPID STRENGTH CONCRETE BASE					
Modulus of rupture (7-days)	California Test 524	3 beams - 6x6x20 inches	Concrete truck discharge chute	1 per 500 cu yd or 1 day's production if less than 500 cu yd	
LEAN CONCRETE BASE RAPID SETTING					
Compressive strength (7-days)	California Test 521	6 cylinders 6x12 in. - 3 tests	Concrete truck discharge chute	1 per 500 cu yd or 1 day's production if less than 500 cu yd	
CONCRETE BASE					
Modulus of rupture (7-days)	California Test 523	2 beams of 6x6x32 in. for centerpoint loading or 6x6x20 in. for third-point loading	Concrete truck discharge chute	1,000 cu yd or 1 day's production if less than 1,000 cu yd	
Dimensions	N/A	N/A	Random locations	As necessary for acceptance	Verify thickness of base

Note:
1. Refer to California Test 125 for sampling procedures.

Table 6-1.10. Materials Acceptance Sampling and Testing Requirements:
Treated Permeable Bases (*Standard Specifications* Section 29)
Asphalt Treated Permeable Base (ATPB) (1 of 4)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
AGGREGATE					
Percentage Crushed Particles	California Test 205	Combined two 40-lb canvas bags (See Note 2) or Batch 160 lb (proportioned per bin percentages)	Plant	Before production and minimum 1 random for every 50,000 tons or less of paving	
Los Angeles Abrasion Testing (at 500 revolutions)	California Test 211	Combined two 40-lb canvas bags (See Note 2) or Batch 160 lb (proportioned per bin percentages)	Plant	Before production and minimum 1 random for every 50,000 tons or less of paving	
Film Stripping	California Test 302	Combined two 40-lb canvas bags (See Note 2) or Batch 160 lb (proportioned per bin percentages)	Plant	Before production and minimum 1 random for every 50,000 tons or less of paving	
Gradation (Sieve Analysis)	California Test 202	Combined two 20-lb canvas bags (See Note 3) or Batch 40 lb (proportioned per bin percentages)	Plant	1 for every 4 hours of production	

Table 6-1.10. Materials Acceptance Sampling and Testing Requirements:
Treated Permeable Bases (*Standard Specifications* Section 29)
Asphalt Treated Permeable Base (ATPB) (2 of 4)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
AGGREGATE (Cont.)					
Cleanness Value	California Test 227	Combined two 20-lb canvas bags (See Note 3) or Batch 40 lb (proportioned per bin percentages)	Plant	1 for every 4 hours of production	Recommend 1 acceptance test per day if 3 consecutive results exceed 62
ASPHALT					
Various properties based on asphalt type used; see *Standard Specifications* Section 92	Based on asphalt type used; see *Standard Specifications* Section 92	1-qt double-seal friction-top metal cylindrical shaped can	Asphalt feed line connecting plant storage tanks	1 per day	Certificate of compliance required for each shipment; if asphalt binder source is not on approved list, sample and test asphalt before use
COMPLETED MIX					
Asphalt Content	California Test 382	40 lb in metal containers	Plant, truck, windrow, or roadbed	1 for every 4 hours of production	
AGGREGATE					
Los Angeles Abrasion Testing (loss at 500 revolutions)	California Test 211	50 lb	Plant	Before production and minimum 1 random for every 25,000 cu yd	
Soundness	California Test 214	50 lb	Plant		
Sieve Analysis (Gradation)	California Test 202	40 lb	Plant	1 for every 4 hours of production; (See Note 4)	

Table 6-1.10. Materials Acceptance Sampling and Testing Requirements:
Treated Permeable Bases (*Standard Specifications* Section 29)
Asphalt Treated Permeable Base (ATPB) (3 of 4)

Test	Test Method	Sample Size & Container Size	Sampling Location (See Note 1)	Acceptance Test Frequency	Remarks
AGGREGATE (Cont.)					
Cleanness Value	California Test 227				
CEMENT					
Cement, various properties; must comply with *Standard Specifications* Section 90-1.02B(2)	Must comply with *Standard Specifications* Section 90-1.02B(2)	8 lb	Concrete plant	1 for each 100 tons, 2 per day max	Recommend 1 acceptance test per project for cement from approved suppliers with certificate of compliance
WATER					
Chlorides	California Test 422	Clean 2-qt plastic jug with lined, sealed lid At point of use; see Remarks	1 per source		Water supplies for domestic use do not need to be tested
Sulfates	California Test 417	Clean 2-qt plastic jug with lined, sealed lid At point of use; see Remarks	1 per source		Water supplies for domestic use do not need to be tested
Setting Time	ASTM C 191 or ASTM C 266	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Mortar Compressive Strength	ASTM C109	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Coloring Agents	Must comply with *Standard Specifications* Section 90-1.02D	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested

Table 6-1.10. Materials Acceptance Sampling and Testing Requirements:
Treated Permeable Bases (*Standard Specifications* Section 29)
Asphalt Treated Permeable Base (ATPB) (4 of 4)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
WATER					
Alkalis	Must comply with *Standard Specifications* Section 90-1.02D	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Specific Gravity	Must comply with *Standard Specifications* Section 90-1.02D	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested

Notes:
1. Refer to California Test 125 for sampling procedures.
2. Store one 40-lb canvas bag for dispute resolution.
3. Store one 20-lb. canvas bag for dispute resolution.
4. If test records determine that aggregate gradation or cleanness value is close to specification limit or outside the specification limits, sample and test concrete every 300 cu yd so that deductions may be taken for noncompliant material.

Table 6-1.11. Materials Acceptance Sampling and Testing Requirements: Recycled Pavement (*Standard Specifications* Section 30)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
FULL-DEPTH RECYCLING WITH NO STABILIZER (Section 30-2)					
Thickness	Thickness-Field Measurement	Field Measurement	Random location	3 per lot	
Relative Compaction (% min)	California Test 231	Sample for California Test 216	In accordance with California Test 231	1 every 2,000 sq yd and test compaction at every 6 in. of thickness	
FULL DEPTH RECYCLING–FOAMED ASPHALT (Section 30-3)					
Relative Compaction (% min)	California Test 231	Sample for California Test 216	In accordance with California Test 231	1 every 2,000 sq yd and test compaction at every 6 in. of thickness	
Thickness	Thickness	California Test 531. 4- or 6-in.-diameter core, full thickness	3 random locations per lot	See Section 4-4004 of this manual	
FULL DEPTH RECYCLING—CEMENT (Section 30-4)					
Thickness	Thickness-Core thickness measurement	California Test 531, 4- or 6-in.-diameter core, full thickness	3 random locations per lot	See Section 4-4004 of this manual	
Cement application rate	Calibrated tray or equal	Building paper or pan of known area	Surface receiving cement	Each 40,000 sq ft, 2 per day minimum	Determine if application rate is within ± 5% of mix design rate
Relative Compaction (% min)	California Test 231	Sample for California Test 216	In accordance with California Test 231	1 every 2,000 sq yd and test compaction at every 6 in. of thickness	

Notes:

1. Refer to California Test 125 for sampling procedures.

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (1 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
ASPHALTIC EMULSION AND ASPHALTIC EMULSION FOR FLUSH COAT					
Various properties in accordance with Section 37 of *Standard Specifications*	See Section 37-2.02A(4)(b)(ii) of *Standard Specifications*	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Transport tanker	Each shipment	Certificate of compliance required with each shipment
Asphaltic emulsion spread rate	CT 339	Per test method	Full width of boot truck	Once per project	
POLYMER MODIFIED ASPHALTIC EMULSION					
Viscosity	AASHTO T 59	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Transport tanker	Each shipment	Certificate of compliance required with each shipment
Sieve Test	AASHTO T 59	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Transport tanker	Each shipment	Certificate of compliance required with each shipment
Demulsibility	AASHTO T 59	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Transport tanker	Each shipment	Certificate of compliance required with each shipment

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (2 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
POLYMER MODIFIED ASPHALTIC EMULSION (Cont.)					
Torsional Recovery	California Test 332	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Transport tanker	Each shipment	Certificate of compliance required with each shipment
Penetration	AASHTO T 49	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Transport tanker	Each shipment	Certificate of compliance required with each shipment
Ring and Ball	AASHTO T 53	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Transport tanker	Each shipment	Certificate of compliance required with each shipment

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (3 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
ASPHALT MODIFIER FOR ASPHALT RUBBER BINDER					
Viscosity	ASTM D445	1-qt round wide-mouth can with friction top lid or 1-qt rectangular can with screw-on lid	Sample port on tanker truck	1 random per project	
Flash Point	ASTM D92	1-qt round wide-mouth can with friction top lid or 1-qt rectangular can with screw-on lid	Sample port on tanker truck	1 random per project	
Molecular Analysis	ASTM D2007	1-qt round wide-mouth can with friction top lid or 1-qt rectangular can with screw-on lid	Sample port on tanker truck	1 random per project	
CRUMB RUBBER MODIFIER FOR ASPHALT RUBBER BINDER					
Wire in CRM (max %)	CT 385	CRM scrap tire: Two 2.5 lb in gallon zip-lock bags CRM high natural: Two 2.5 lb in gallon zip-lock bags	CRM bulk bag	Minimum 1 random per project	

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (4 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CRUMB RUBBER MODIFIER FOR ASPHALT RUBBER BINDER (Cont.)					
Fabric in CRM (max %)	CT 385	CRM scrap tire: Two 2.5 lb in gallon zip-lock bags CRM high natural: Two 2.5 lb in gallon zip-lock bags	CRM bulk bag	Minimum 1 random per project	
CRM particle length		CRM scrap tire: Two 2.5 lb in gallon zip-lock bags CRM high natural: Two 2.5 lb in gallon zip-lock bags	CRM bulk bag	Minimum 1 random per project	
CRM specific gravity	CT 208				
Natural rubber content in high nature CRM (%)	ASTM D297				
ASPHALT RUBBER BINDER					
Cone Penetration		1-qt double-seal friction-top metal cylindrical shaped can	Asphalt feed line connecting to the HMA plant	Production start-up evaluation and 1 random per 5 samples	Certificate of compliance required with each shipment

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (5 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
ASPHALT RUBBER BINDER (Cont.)					
Resilience		1-qt double-seal friction-top metal cylindrical shaped can	Asphalt feed line connecting to the HMA plant	Production start-up evaluation and 1 random per 5 samples	Certificate of compliance required with each shipment
Softening point		1-qt double-seal friction-top metal cylindrical shaped can	Asphalt feed line connecting to the HMA plant	Production start-up evaluation and 1 random per 5 samples	Certificate of compliance required with each shipment
Asphalt Rubber Binder Viscosity	ASTM D7741	1 gal metal cylindrical shaped can with double-seal friction top	Asphalt storage tank	The greater of 1 every 5 lots or once a day	For safety, engineer may witness contractor perform test
Base Asphalt Binder Properties	See *Standard Specifications* Section 92	Five 1-qt double-seal friction-top metal cylindrical shaped can	Asphalt storage tank	The greater of 1 every 5 lots or once a day	Certificate of compliance required for each shipment; if asphalt binder source is not on approved list, test before use
SCREENINGS/AGGREGATE FOR CHIP SEALS					
Los Angeles Abrasion Testing	California Test 211	50 lb in canvas bags or 5-gal buckets	Stockpile	Once per project	
% Crushed Particles	AASHTO T 335	50 lb in canvas bags or 5-gal buckets	Stockpile	Once per project	

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (6 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
SCREENINGS/AGGREGATE FOR CHIP SEALS					
Film Stripping	California Test 302	50 lb in canvas bags or 5-gal buckets	Stockpile	Once per project	
Sieve Analysis	California Test 202	30 lb	Stockpile	Twice daily	
Cleanness Value	California Test 227	30 lb	Stockpile	Once daily	
SAND FOR FLUSH COAT					
Sieve Analysis	California Test 202	25 lb	Stockpile	Once per project	
CRACK TREATMENTS					
Crack Treatment Material					
Softening point	ASTM D36	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of crack treatment material on the TL-0101
Cone penetration	ASTM D5329	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of crack treatment material on the TL-0101
Resilience	ASTM D5329	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of crack treatment material on the TL-0101

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (7 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CRACK TREATMENTS (Cont.)					
Crack Treatment Material					
Tensile adhesion	ASTM D5329	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of material on the TL-0101
Asphalt compatibility	ASTM D5329	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of material on the TL-0101
Flexibility	ASTM D3111	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of material on the TL-0101
Specific gravity	ASTM D70	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of material on the TL-0101
Sieve test	See note in Section 37-6.01D(3) "Department Acceptance" of the *Standard Specifications*	2 each 3-lb minimum samples in silicone release boxes	From crack treatment material dispensing wand	Once per project	Indicate the specified type of material on the TL-0101

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements: Seal Coats (*Standard Specifications* Section 37) (8 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
SAND FOR CRACK TREATMENT					
Sieve Analysis	California Test 202	25 lb	Stockpile	Once per project	
SLURRY SEAL AGGREGATE					
Los Angeles Abrasion Testing (loss at 500 revolutions)	California Test 211	50 lb	Stockpile	Once per project	
Percentage of Crushed Particles	California Test 205	50 lb	Stockpile	Once per project	
Film Stripping	California Test 302	50 lb	Stockpile	Once per project	
Durability Index	California Test 229	50 lb	Stockpile	Once per project	
Sieve Analysis	California Test 202, California Test 105	30 lb	Stockpile	Once daily	
Sand Equivalent	California Test 217	30 lb	Stockpile	Once daily	
MICRO-SURFACING AGGREGATES					
Los Angeles Abrasion Testing (loss at 500 revolutions)	California Test 211	50 lb	Stockpile	Once per project	
Percentage of Crushed Particles	California Test 205	50 lb	Stockpile	Once per project	
Durability Index	California Test 302	50 lb	Stockpile	Once per project	

Table 6-1.12. Materials Acceptance Sampling and Testing Requirements:
Seal Coats (*Standard Specifications* Section 37) (9 of 9)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
MICRO-SURFACING AGGREGATES (Cont.)					
Sieve Analysis	California Test 202	30 lb	Stockpile	Once daily	
Sand Equivalent	California Test 217	30 lb	Stockpile	Once daily	

Note:
1. Refer to California Test 125 for sampling procedures.

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (1 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
AGGREGATE: All Types of HMA						
Gradation (Sieve Analysis) (See Note 2)	AASHTO T 30, AASHTO T 308, California Test 105, California Test 384	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant	For standard process, 1 for each 750 tons, 1 per day minimum For statistical pay factor (SPF) process, per stratified random sampling plan (See Notes 10 and 11)	Production start-up evaluation. For standard process, minimum 1 per day of paving For SPF process, test per stratified random sampling plan (See Note 14)	
Sand Equivalent	AASHTO T 176	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant or before lime treatment	For standard process, 1 for each 750 tons, 1 per day minimum, For SPF process, same frequency as gradations	Production start-up evaluation. For standard process, minimum 1 per day of paving For SPF process, test with gradation samples	Not required for OGFC (open graded friction course)

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (2 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
AGGREGATE: All Types of HMA						
Percent Crushed Particles (Coarse)	AASHTO T 335	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant or before lime treatment	1 for each 750 tons, 1 per day minimum For the SPF process, see Note 17	Production start-up evaluation, and minimum 1 random for every 25,000 tons or less of paving For the SPF process, see Note 17	
Percent Crushed Particles (Fine)	AASHTO T 335	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant or before lime treatment	1 for each 750 tons, 1 per day minimum For the SPF process, see Note 17	Production start-up evaluation, and minimum 1 random for every 25,000 tons or less of paving For the SPF process, see Note 17	
Los Angeles Abrasion Testing (500 Revolutions)	AASHTO T 96	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant or before lime treatment	1 for each 750 tons, 1 per day minimum For the SPF process, see Note 17	Production start-up evaluation, and minimum 1 random for every 50,000 tons or less of paving For the SPF process, see Note 17	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (3 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
AGGREGATE: All Types of HMA (Cont.)						
Los Angeles Abrasion Testing (100 Revolutions)	AASHTO T 96	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant or before lime treatment	1 for each 750 tons, 1 per day minimum For the SPF process, see Note 17	Production start-up evaluation, and minimum 1 random for every 50,000 tons or less of paving For the SPF process, see Note 17	
Fine Aggregate Angularity	AASHTO T 304, Method A	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant or before lime treatment	1 for each 750 tons, 1 per day minimum For the SPF process, see Note 17	Production start-up evaluation, and minimum 1 random for every 50,000 tons or less of paving For the SPF process, see Note 17	Not required for OGFC or Minor HMA
Flat and Elongated Particles	ASTM D4791	Combined six 20-lb canvas bags (See Note 3) or Batch 30 lb (proportioned per bin percentages)	HMA plant or before lime treatment	1 for each 750 tons, 1 per day minimum For the SPF process, see Note 17	Production start-up evaluation, and minimum 1 random for every 50,000 tons or less of paving For the SPF process, see Note 17	Not required for Minor HMA

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (4 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
ASPHALT BINDER						
Various properties based on asphalt type used (see *Standard Specifications* Section 92)	See *Standard Specifications* Section 92	1-qt double-seal friction-top metal cylindrical shaped can	Asphalt feed line connecting the plant storage tanks	1 per day of HMA production	1 random for every 5 samples	Certificate of compliance required for each shipment; if asphalt binder source is not on approved list, sample and test asphalt before use
ASPHALT RUBBER BINDER						
Asphalt Rubber Binder Properties	See *Standard Specifications* Section 39-2.03A(4)(e)(ii)	1-qt double-seal friction-top metal cylindrical shaped can	Asphalt rubber feed line from the HMA plant	1 every lot	Production start-up evaluation and 1 random per 5 samples	Certificate of compliance required for each lot
Asphalt Rubber Binder Viscosity	ASTM D7741	1 gal double-seal friction-top metal cylindrical shaped can	Asphalt rubber feed line connecting to the HMA plant	1 every lot	1 every lot	For safety, engineer may witness contractor perform test

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (5 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
ASPHALT RUBBER BINDER (Cont.)						
Base Asphalt Binder Properties	See *Standard Specifications* Section 92	1-qt double-seal friction-top metal cylindrical shaped can	Asphalt storage tank	Each shipment	Production start-up evaluation and 1 random per 5 samples	Certificate of compliance required for each shipment; if asphalt binder source is not on approved list, sample and test asphalt before use
Asphalt Modifier Properties	ASTM D445 ASTM D92 ASTM D2007	1-qt double-seal friction-top metal cylindrical shaped can or 1-qt rectangular can with screw-on lid	Sample port on tanker truck	Each shipment	1 random per project	
Crumb Rubber Modifier (CRM) Properties	California Test 208, California Test 385, ASTM D297	CRM scrap tire: Two 2.5 lb in gallon zip-lock bags; CRM high natural: Two 2.5 lb in gallon zip-lock bags	CRM bulk bag	Each shipment	1 random per project	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (6 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
HOT MIX ASPHALT: Type A						
Moisture Content	AASHTO T 329	10 lb, sealed metal container	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, and minimum 1 per project	Production start-up evaluation, and minimum 1 per project during paving	Test within 1 hour of sampling
Asphalt Binder Content	AASHTO T 308, Method A	60 lb (See Notes 5 and 18) (8x8x4=6 boxes, 8½x8½x4½=4 boxes) (See Notes 5 and 18)	Loose mix from behind the paver (See Note 4)	For standard process, 1 for each 750 tons, 1 per day minimum. For SPF process, per stratified random sampling plan (See Notes 10 and 11)	Production start-up evaluation; For standard process, minimum 1 per day of paving For SPF process, per stratified random sampling plan (See Note 14)	
Maximum Theoretical Density	AASHTO T 209	60 lb (See Notes 5 and 18) (8x8x4=6 boxes, 8½x8½x4½=4 boxes) (See Notes 5 and 18)	Loose mix from behind the paver (See Note 4)	For standard process, 1 for each 750 tons, 1 per day minimum For SPF process, two samples per shift with verification density cores (See Notes 10 and 13)	Production start-up evaluation. For standard process, 1 random test per day of paving For SPF process, per stratified random sampling plan	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (7 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (See Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
HOT MIX ASPHALT: Type A (Cont.)						
Air Void Content	AASHTO T 269	100 lb (See Note 5) (8x8x4=10 boxes, 8½x8½x4½=8 boxes)	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, 1 every 25,000 tons of paving. For HMA placed using SPF, see Notes 10 and 11	Production start-up evaluation, and minimum 1 random for every 25,000 tons of paving, except for HMA placed using SPF, see Note 14	
Voids in Mineral Aggregate	SP-2 Asphalt Mixture Volumetrics	100 lb (See Note 5) (8x8x4=10 boxes, 8½x8½x4½=8 boxes)	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, 1 every 25,000 tons of paving	Production start-up evaluation, and minimum 1 random for every 25,000 tons of paving	
Dust Proportion	SP-2 Asphalt Mixture Volumetrics	100 lb (See Note 5) (8x8x4=10 boxes, 8½x8½x4½=8 boxes)	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, 1 every 25,000 tons of paving	Production start-up evaluation, and minimum 1 random for every 25,000 tons of paving	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (8 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
HOT MIX ASPHALT: Type A (Cont.)						
Hamburg Wheel Track	California Test 389	70 lb (See Notes 5 and 18) (8x8x4=7 boxes, 8½x8½x4½=6 boxes)	Loose mix at plant, truck, or windrow	Production start-up evaluation, 1 every 10,000 tons of paving For SPF process, see Note 16	Production start-up evaluation, and minimum 1 random for every 10,000 tons or less of paving For SPF process, see Note 16	Not required for Minor HMA
Moisture Susceptibility	AASHTO T 283	140 lb (See Notes 5, 6 and 18) (8x8x4=15 boxes, 8½x8½x4½=12 boxes)	Loose mix at plant, truck, or windrow	Production start-up evaluation, 1 every 50,000 tons of paving	Production start-up evaluation, and minimum 1 random test for every 50,000 tons of paving	Test for dry strength and wet strength; not required for Minor HMA
HOT MIX ASPHALT: With RAP/RAS						
Binder Recovery	AASHTO T 164 ASTM D1856	10 lb (8x8x4=1 box, 8½x8½x4½=1 box) (See Note 18)	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, 1 every 25,000 tons of paving	1 random for every 25,000 tons or less of paving	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (9 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
RUBBERIZED HOT MIX ASPHALT: Gap Graded						
Moisture Content	AASHTO T 329	10 lb, sealed metal container	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, and minimum 1 per project	Production start-up evaluation, and minimum 1 per project during paving	Test within 1 hour of sampling
Asphalt Binder Content	AASHTO T 308, Method A	60 lb (See Notes 5 and 18) (8x8x4=6 boxes, 8½x8½x4½=4 boxes)	Loose mix from behind the paver (See Note 4)	1 for each 750 tons, 1 per day minimum. For HMA placed using SPF, see Notes 10 and 11	Production start-up evaluation; 1 random test per day of paving. For HMA placed using SPF, see Note 10	
Maximum Theoretical Density	AASHTO T 209	60 lb (See Notes 5 and 18) (8x8x4=6 boxes, 8½x8½x4½=4 boxes)	Loose mix from behind the paver (See Note 4)	1 for each 750 tons, 1 per day minimum. For HMA placed using SPF, see Notes 11 and 13	Production start-up evaluation; minimum 1 per day of paving, except for HMA placed using SPF, see Notes 10 and 13	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (10 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
RUBBERIZED HOT MIX ASPHALT: Gap Graded (Cont.)						
Air Void Content	AASHTO T 269	100 lb (See Notes 5 and 18) (8x8x4= 10 boxes, 8½x8½x4½=8 boxes)	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, 1 every 25,000 tons of paving. For HMA placed using SPF, see notes 10 and 11	Production start-up evaluation, and minimum 1 random test for every 25,000 tons of paving For SPF process, test per stratified random sampling plan. See note 14	
Voids in Mineral Aggregate	SP-2 Asphalt Mixture Volumetrics	100 lb (See Notes 5 and 18) (8x8x4= 10 boxes, 8½x8½x4½=8 boxes)	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, 1 every 25,000 tons of paving	Production start-up evaluation, and minimum 1 random test for every 25,000 tons of paving	
Dust Proportion	SP-2 Asphalt Mixture Volumetrics	100 lb (See Notes 5 and 18) (boxes, 8x8x4=10 boxes, 8½x8½x4½=8 boxes)	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, 1 every 25,000 tons of paving	Production start-up evaluation, and minimum 1 random test for every 25,000 tons of paving	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (11 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
RUBBERIZED HOT MIX ASPHALT: Gap Graded (Cont.)						
Hamburg Wheel Track	California Test 389	75 lb (See Notes 5 and 18) (8x8x4=7 boxes, 8½x8½x4½=6 boxes)	Loose mix at plant, truck, or windrow	Production start-up evaluation 1 every 10,000 tons of paving For SPF process, see Note 16	Production start-up evaluation, and minimum 1 random test for every 10,000 tons or less of paving For SPF process, see Note 16	
Moisture Susceptibility	AASHTO T 283	75 lb (See Notes 5, 6 and 18) (8x8x4= 15 boxes, 8½x8½x4½=12 boxes)	Loose mix at plant, truck, or windrow	Production start-up evaluation, 1 every 50,000 tons of paving	Production start-up evaluation, and minimum 1 random test for every 50,000 tons of paving	Test for dry strength and wet strength
OPEN GRADED FRICTION COURSE (OGFC)						
Asphalt Binder Content	AASHTO T 308, Method A	20 lb (See Note 5) 4, 1-gal metal containers with friction lids	Loose mix from behind the paver (See Note 4)	1 for each 750 tons, 1 per day minimum	Production start-up evaluation; minimum 1 per day of paving	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (12 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
OPEN GRADED FRICTION COURSE (OGFC) (Cont.)						
Moisture Content	AASHTO T 329	10 lb, sealed metal container	Loose mix from behind the paver (See Note 4)	Production start-up evaluation, and minimum 1 per project	Production start-up evaluation, and minimum 1 per project during paving	Test within 1 hour of sampling
BONDED WEARING COURSE: Gap Graded (BWC-G) (See Note 7)						
Asphalt Binder Content	AASHTO T 308, Method A	20 lb (See Note 5) 4, 1-gal metal containers with friction lids	Loose mix at plant	1 for each 750 tons, 1 per day minimum	Production start-up evaluation. Minimum 1 per day of paving	
Moisture Content	AASHTO T 329	10 lb sealed metal container	Loose mix at plant	Production start-up evaluation, and minimum 1 per project	Production start-up evaluation, and minimum 1 per project during paving	Samples should be tested within 1 hour of sampling
PAVEMENT DENSITY						
Density of cores (% of maximum theoretical density) (See Note 8)	California Test 375	4- or 6–in cores	Final layer, cored to the specified total paved thickness	For the standard process, 1 for each 250 tons For the SPF process, see Note 12	For the standard process, 1 for each 250 tons For SPF process, test per stratified random sampling plan. See Note 14	Density applies to HMA thickness of 0.15 ft or greater

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (13 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (See Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
PAVEMENT SMOOTHNESS						
Straightedge	N/A	N/A	Pavement surface (See Note 9)	Entire final surface	Entire final surface	Areas exempt from Inertial Profiler
Inertial Profiler for Mean Roughness Index and Areas of Localized Roughness	California Test 387 AASHTO R 56 & AASHTO R 57	Each 0.1 mile	Pavement surface	Entire final surface	Entire final surface	Entire final surface excluding areas requiring straightedge; use contractor-furnished profiles for IRI values within 10% of Caltrans' IRI values
TACK COAT						
Asphalt Binder	Based on asphalt type used (see *Standard Specifi-cations* Section 92)	1-qt double-seal friction-top metal cylindrical shaped can	Spray bar on asphalt distributor truck	Each truckload	1 random per project	

Table 6-1.13. Materials Acceptance Sampling and Testing Requirements: Asphalt Concrete (*Standard Specifications* Section 39) (14 of 14)

Test	Test Method	Sample Size & Container Type	Sampling Location (See Note 1)	Sampling Frequency	Acceptance Test Frequency	Remarks
TACK COAT (Cont.)						
Spread Rate	California Test 339	N/A	Pavement	N/A	As necessary for verification of tack coat spread rate	Verify tack coat spray rate is sufficient to meet the minimum specified residual rate. (See example in Section 4-9403, "During the Course of Work," in this manual)
Asphaltic Emulsion	Based on emulsion type used (see *Standard Specifi-cations* Section 94)	1 liter (or 1 qt) wide-mouth plastic bottle with screw on lids that are sealed with tape	Spray bar on emulsion distributor truck	Each truckload	1 random per project	

Notes:

1. Refer to California Test 125 for sampling procedures.
2. When using RAP, RAS, or RAP/RAS, adjust gradation by the correction factor determined under California Test 384.
3. Store three 20-lb canvas bags for dispute resolution.
4. Sampling HMA behind the paver is the preferred location. You may also take samples from the windrow, production plant, or truck.
5. Sample sizes are based on split samples—one sample for acceptance testing, and one for dispute resolution. Store one-half of the boxes or cans for dispute resolution.

6. Contractor ships directly to district material laboratory.
7. For bonded wearing course using RHMA-G, RHMA-O, or HMA-O, sampling and testing must comply with requirements for RHMA-G, RHMA-O, or HMA-O.
8. Determine percent of maximum theoretical density under California Test 375, except use AASHTO T 275 to determine in-place density of each core and AASHTO T 209, Method A to determine maximum theoretical density instead of calculating maximum density.
9. May use Inertial Profiler data and ProVAL Rolling Straightedge module to assist in determining where to check with 12-foot straightedge.
10. For the statistical pay factor (SPF) process, and for each lot, prepare a stratified random sampling plan for the following pay factor quality characteristic: aggregate gradations, binder content, air voids, and percent of maximum theoretical density. Sample at milestones identified in the stratified random sampling plan. Do not share the verification sampling time or location with the contractor until immediately before sampling. Do not share the stratified random sampling plan with the contractor until completion of the lot. For guidance on developing the engineer's stratified random sampling plans, refer to section 4-3902K, "Stratified Random Sampling Plan" of this manual.
11. Obtain enough material to split each sample into four parts. Perform verification testing on one part, provide one part to the contractor, hold one part for dispute resolution testing, and reserve the fourth part for additional verification testing in the event the lot runs short and you do not have at least the 3 tests needed for verification.
12. To determine in-place density, obtain verification density cores from the contractor's sublot identified in the engineer's stratified random sampling plan. Break the identified sublot into three equal parts, and randomly determine the coring location of each part. At each location, core three samples aligned longitudinally within 1 to 2 feet of the center core. Retain the center core for verification testing, and randomly determine which of the two remaining cores will be provided to the contractor and which will be retained by the engineer.
13. To determine the paving shift's maximum theoretical density value used for verification of percent in-place density, obtain two samples of HMA from each paving shift the verification density cores are obtained from. Determine the shift's maximum theoretical density value used for the verification by averaging the test results of the two samples. The two samples must be obtained randomly from the first and last half of the paving shift, or from a split of a single sample pulled within the sublot the density cores are obtained from.
14. Do not share the test results of pay factor quality characteristics with the contractor until completion of the lot.
15. For HMA placed using SPF, during production, sample non-pay factor items at the frequency determined by the engineer. Notify the contractor of your intent to sample, and obtain enough material to split into four parts. Test one part, provide one part to the contractor, and retain one part for independent third party testing. When sampling for non-pay factors, except sand equivalent testing, pull two samples from two consecutive sublots. If the first sample fails, immediately test the second sample. Refer to Section 4-3904A(5), "Monitoring Non-Pay Factor Quality Characteristics Using Statistical Pay Factor Specifications" of this manual for guidance related to non-pay factor testing.
16. For HMA placed using SPF, when sampling for Hamburg Wheel Track, pull one additional sample for testing from the contractor's next sublot. Test this second sample if the first sample fails.

17. For HMA placed using SPF, sample at same frequency as aggregate gradations, except pull two samples and test the second sample if the first sample fails.
18. Box quantities indicated represent recommended amounts for each individual test. Use CT 125 Appendix B Table 1 for more comprehensive quantities or suites of tests.

Table 6-1.14. Materials Acceptance Sampling and Testing Requirements: Concrete Pavement (*Standard Specifications* Section 40) (1 of 2)
See Table 6-1.17. for concrete materials

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CONCRETE					
Modulus of Rupture (Open to Traffic)	California Test 523 (Field Curing)	3 beams of 6x6x20 in. for third-point loading	Concrete truck discharge chute	1 set for the last pavement section placed before opening to traffic	Not used for acceptance, only to verify that pavement can be opened to traffic
Compressive Strength Equivalent to Modulus of Rupture (42-days)	California Test 540, California Test 521	3 cylinders of the same size (either 6x12 in. or 4x8 in.) for compressive strength equivalent to Modulus of Rupture	Concrete truck discharge chute	1 set per age for each 1,000 cu yd, 1 per day minimum (See Note 2)	Recommend frequency of every 2,000 cu yd if after 10 sets all tests are in compliance
Air Content	California Test 504	See test method	Concrete truck discharge chute	1 every day of production	Only test when air entrainment is specified
Use of the Maturity Method (Open to Traffic)	ASTM C1074, California Test 523 (Field Curing), California Test 540, California Test 521	Contractor develops the strength-maturity relationship using specimens prepared under ASTM C1074	Estimate in-place strength of concrete based on strength-maturity relationship per ASTM C1074 and sensors embedded in the concrete placement	Place a sensor at the beginning and end of the concrete placement	Not used for acceptance, only to verify that pavement can be opened to traffic. Contractor validates test strip once and every 15,000 cu yd or 30 days, whichever comes first.

Table 6-1.14. Materials Acceptance Sampling and Testing Requirements: Concrete Pavement (*Standard Specifications* Section 40) (2 of 2)
See Table 6-1.17. for concrete materials

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
PAVEMENT					
Thickness	California Test 531	4-in. diameter core, full thickness of pavement	See Section 4-4004, "Level of Inspection," of this manual	1 every 1,200 sq yd	
Dowel Bar Alignment and Concrete Consolidation	Measurement and Inspection	4-in. diameter core size	Transverse pavement joints	1 test every 700 sq yd	Each test consists of 2 cores, one on each end of dowel bar
Tie Bar Alignment and Concrete Consolidation	Measurement and Inspection	4-in. diameter core size	Longitudinal pavement joints	1 test every 4,000 sq yd	Each test consists of 2 cores, one on each end of tie bar
Smoothness - Straightedge	Measurement with 12-ft straightedge	N/A	Pavement surface	Entire final surface requiring straightedge	
Smoothness - Inertial Profiler for Mean Roughness Index and Areas of Localized Roughness	AASHTO R 56, AASHTO R 57, and California Test 387	0.1 mile	Pavement surface	Entire final surface	Entire final surface excluding areas requiring straightedge; use contractor-furnished profiles for IRI values within 10% of Caltrans' IRI values

Notes:

1. Refer to California Test 125 for sampling procedures.
2. If concrete compressive strength is close to specification limit or outside the specification limits, sample and test concrete every 1,000 cu yd so that deductions may be taken for noncompliant material.

Table 6-1.15. Materials Acceptance Sampling and Testing Requirements: Existing Concrete Pavement (*Standard Specifications* Section 41)

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
INDIVIDUAL SLAB REPLACEMENT WITH RAPID STRENGTH CONCRETE (Section 41-9)					
Smoothness - Straightedge	Measurement with 12-ft straightedge	N/A	Pavement surface	Entire final surface	Areas exempt from Inertial Profiler
Modulus of rupture (3-days)	California Test 524	3 beams of 6x6x20 inches	Concrete truck discharge chute	1 per shift	

Notes:

1. Refer to California Test 125 for sampling procedures.

Table 6-1.16. Materials Acceptance Sampling and Testing Requirements: Concrete Structures (*Standard Specifications* Section 51)
See Table 6-1.17. for concrete materials

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
JOINT SEALS TYPE B (Section 51-2.02C)					
Various properties; must comply with *Standard Specifications* Section 51-2.02C(2)	See *Standard Specifications* Section 51-2.02C(2)	1 piece, 3 ft	Job site	Each lot	Certificate of compliance and certified test report required for each lot; test report must include the seal movement range, manufacturer minimum uncompressed width and test results; submit samples at least 30 days before use
JOINT SEALS TYPE A AND TYPE AL (Section 51-2.02B)					
	Use Authorized Materials List at: https://dot.ca.gov/programs/engineering-services/authorized-materials-lists			Type A and AL joint seals must be on the Authorized Materials List for Type A and AL joint seals	Submit a certificate of compliance for each batch of sealant at least 15 days before use

Notes:

1. Refer to California Test 125 for sampling procedures.

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (1 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
AGGREGATE: Coarse Aggregate					
Los Angeles Abrasion Testing (loss at 500 revolu-tions)	Cali-fornia Test 211	See Note 2	Stockpile	Before production and minimum 1 random test for every 25,000 cu yd	1 for every 4,000 cu yd, if initial test shows abrasion loss greater than 40%
Clean-ness Value	Cali-fornia Test 227	25 lb	Stockpile	Before production and minimum 1 for every 600 cu yd, 1 per day minimum	Recommend 1 acceptance test per day if 3 consecutive results exceed 80; increase sampling to 1 for every 300 cu yd (deductive lot) with engineer's authorization
Sieve Analysis	Cali-fornia Test 202	50 lb	Belt Feed	Before production and minimum 1 for every 600 cu yd, 1 per day minimum	Recommend 1 acceptance test per day if 3 consecutive results are within operating range; increase sampling to 1 for every 300 cu yd (deductive lot) with engineer's authorization
AGGREGATE: Fine Aggregate					
Organic Impurities	Cali-fornia Test 213	See Note 2	Stockpile	Before production or when contamination is suspected	
Durability	Cali-fornia Test 229	See Note 2	Stockpile	Before production	
Sand Equivalent	Cali-fornia Test 217	25 lb	Stockpile	Before production and minimum 1 for every 600 cu yd, 1 per day minimum	Recommend 1 acceptance test per day if 3 consecutive results exceed 80; increase sampling to 1 for every 300 cu yd (deductive lot) with engineer's authorization

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements:
Concrete (*Standard Specifications* Section 90) (2 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
AGGREGATE: Fine Aggregate					
Sieve Analysis	California Test 202	50 lb	Belt feed	Before production and minimum 1 for every 600 cu yd, 1 per day minimum	Recommend 1 acceptance test per day if 3 consecutive results are within operating range; increase sampling to 1 for every 300 cu yd (deductive lot) with engineer's authorization
AGGREGATE: **Coarse & Fine Aggregate**					
Specific Gravity and Absorption	California Test 206, California Test 207	See Note 2	Stockpile	Before production and when aggregate source changes	
Soundness	California Test 214	See Note 2	Stockpile	Before production	Soundness for fine aggregate waived if durability is ≥ 60
Sieve Analysis (combined gradation determined with fine and coarse aggregate sieve analyses)	California Test 202		N/A	Before production and minimum 1 for every 600 cu yd, 1 per day minimum	Recommend 1 acceptance test per day if 3 consecutive results are within operating range. Increase sampling to 1 for every 300 cu yd (deductive lot) with engineer's authorization

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements:
Concrete (*Standard Specifications* Section 90) (3 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CEMENTITIOUS MATERIALS					
Cement, various properties; must comply with *Standard Specifications* Section 90-1.02B(2)	See *Standard Specifications* Section 90-1.02B(2)	8 lb	Concrete plant	Sample each 100 tons of cement, 2 per day maximum	Cement must be on Authorized Materials List; cement accepted based on certificate of compliance with each shipment; recommend 1 verification test per 5 samples
Supplementary Cementitious Materials (SCM), various properties; must comply with *Standard Specifications* Section 90-1.02B(3)	See *Standard Specifications* Section 90-1.02B(3)	8 lb	Concrete plant	Sample each 100 tons of SCM, 2 per day maximum	SCM must be on Authorized Materials List; SCM accepted based on certificate of compliance with each shipment; recommend 1 verification test per 5 samples
WATER					
Chlorides	California Test 422	Clean 2-qt plastic jug with lined, sealed lid	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Sulfates	California Test 417	Clean 2-qt plastic jug with lined, sealed lid	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Setting Time	ASTM C 191 or ASTM C 266	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements:
Concrete (Standard Specifications Section 90) (4 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
WATER (Cont.)					
Mortar Compressive Strength	ASTM C109	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Coloring Agents	Must comply with *Standard Specifi-cations* Section 90-1.02D	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Alkalis	Must comply with *Standard Specifi-cations* Section 90-1.02D	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested
Specific Gravity	Must comply with *Standard Specifi-cations* Section 90-1.02D	Contact METS for required quantity of water sample	At point of use	1 per source	Water supplies for domestic use do not need to be tested
ADMIXTURES: Air Entraining Agent					
Air entraining properties Must comply with *Standard Specifications* Section 90-1.02E	See *Standard Specifi-cations* Section 90-1.02E	1-qt can or plastic bottle of liquid, 2 lb of powder	Concrete plant	Sample each shipment	Must be on Authorized Materials List and certificate of compliance must accompany each shipment; recommend 1 verification test per 5 samples

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements: Concrete (*Standard Specifications* Section 90) (5 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CHEMICAL ADMIXTURE: Water Reducers or Set Retarders					
Claimed properties, chloride identification	ASTM C494 Type A, B, D, F or Type G California Test 415	1-qt can of liquid, 2 lb of powder	Concrete plant	Sample each shipment	Must be on Authorized Materials List and certificate of compliance must accompany each shipment; recommend 1 verification test per 5 samples
CONCRETE for Pavement and Structures					
Shrinkage	AASHTO T 160 Modified See *Standard Specifications* Section 90-1.01D(3)	Set of three: 4x4x11¼ in.	During mix design process	Before production	Engineer may use contractor-provided test result for acceptance; test results must be within 3 years of contract authorization date
CONCRETE Designated Compressive Strength 3,600 psi or Greater					
Yield	California Test 518	See test method	Concrete truck discharge chute; (See Note 3)	As necessary to assure accuracy of mix design; minimum 2 per each mix design	No deductions for cement content will be made based on the results of California Test 518
Concrete Uniformity	ASTM C143, California Test 533	See test method	Concrete truck discharge chute (See Note 3)	When compressive test specimen is fabricated and when consistency or uniformity is questionable, minimum 2 per day	

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements:
Concrete (*Standard Specifications* Section 90) (6 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location See Note 1)	Acceptance Test Frequency	Remarks
CONCRETE Designated Compressive Strength 3,600 psi or Greater (Cont.)					
Concrete Uniformity	California Test 529	100 lb	Concrete truck discharge chute (See Note 3)	When uniformity is questionable	
Compressive Strength	ASTM C172, California Test 540	1 set of 2 cylinders 6x12 in. or 1 set of 3 cylinders 4x8 in. for each test	Concrete truck discharge chute (See Note 3)	1 set per age for every 300 cu yd concrete or as required for acceptance, minimum 1 set per project	For trial batches, see *Standard Specifications* or job special provisions and Section 6-3, "Field Tests," of this manual
Air Content	California Test 504	See test method	Concrete truck discharge chute (See Note 3)	1 every 4 hours of production and when test specimens are fabricated	Where air is specified for freeze-thaw resistance, a minimum of 1 every 30 cu yd
CONCRETE WITH COMPRESSIVE STRENGTH LESS THAN 3,600 psi					
Concrete Uniformity	ASTM C143, California Test 533	See test method	Concrete truck discharge chute (See Note 3)	When compressive test specimen is fabricated and when uniformity is questionable	

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements:
Concrete (*Standard Specifications* Section 90) (7 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CONCRETE WITH COMPRESSIVE STRENGTH LESS THAN 3,600 psi					
Concrete Uniformity	California Test 529	100 lb	Concrete truck discharge chute (See Note 3)	When uniformity is questionable	
Compressive Strength	California Test 540, California Test 521	1 set of 2 cylinders, 6x12 in. or 1 set of 3 cylinders 4x8 in. for each test	Concrete truck discharge chute (See Note 3)	1 set per age for every 300 cu yd, minimum 1 set per project	
Air Content	California Test 504	See test method	Concrete truck discharge chute (See Note 3)	When compressive test specimens are fabricated	Where air is specified for freeze-thaw resistance, a minimum of 1 every 100 cu yd
CURING COMPOUND					
Curing Compound; must comply with *Standard Specifications* Section 90-1.03B(3)	ASTM C309	1-qt can	At time of use (See Note 1)	1 every shipment	Each shipment must have certificate of compliance that includes: 1. Test results for tests specified in Section 90-1.01D(6) of *Standard Specifications* 2. Certification that material was tested within 12 months before use

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements:
Concrete (*Standard Specifications* Section 90) (8 of 9)
Concrete, Except Minor Concrete and Rapid Strength Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location (Note 1)	Acceptance Test Frequency	Remarks
CEMENTITIOUS MATERIALS					
Cement, various properties; must comply with *Standard Specifications* Section 90-1.02B(2)	See *Standard Specifications* Section 90-1.02B(2)	8 lb	Concrete plant	Sample and test if cement quality is questionable	Cement source must be shown on Authorized Materials List; certificate of compliance must accompany each cement shipment
Supplementary cementitious materials (SCM), various properties; must comply with *Standard Specifications* Section 90-1.02B(3)	See *Standard Specifications* Section 90-1.02B(3)	8 lb	Concrete plant	Sample and test if SCM quality is questionable	SCM source must be shown on Authorized Materials List; certificate of compliance must accompany each SCM shipment
ADMIXTURES: Air Entraining Agent					
Air entraining properties; must comply with *Standard Specifications* Section 90-1.02E	See *Standard Specifications* Section 90-1.02E	N/A	N/A		Must be on Authorized Materials List and certificate of compliance must accompany each shipment
CHEMICAL ADMIXTURES: Water Reducers or Set Retarders					
Claimed properties, chloride identification	ASTM C494 Type A, B, D, F or Type G California Test 415	N/A	N/A		Must be on Authorized Materials List and certificate of compliance must accompany each shipment

Table 6-1.17. Materials Acceptance Sampling and Testing Requirements:
Concrete (*Standard Specifications* Section 90) (9 of 9)
Minor Concrete

Test	Test Method	Sample Size & Container Size	Sampling Location	Acceptance Test Frequency	Remarks
CONCRETE					
Yield	California Test 518	See test method	Concrete truck discharge chute (See Note 3)	As necessary to assure accuracy of mix design; minimum 1 per each mix design	No deductions for cement content will be made based on the results of California Test 518
Com-pressive Strength	California Test 540, California Test 521	1 set of 2 cylinders 6x12 in. or 1 set of 3 cylinders 4x8 in. for each test	Concrete truck discharge chute (See Note 3)	Sample and test if concrete quality is questionable; minimum 1 per mix design	Minor concrete must have the strength described or 2,500 psi, whichever is greater; see *Standard Specifications* Section 90-1.02A
Air Content	California Test 504	See test method	Concrete truck discharge chute (See Note 3)	Where air is specified for freeze-thaw resistance, a minimum of 1 every 100 cu yd	
CURING COMPOUND					
Curing Compound; must comply with *Standard Specifi-cations* Section 90-1.03B(3)	ASTM C309	1-qt can	At time of use; (See Note 1)	1 every shipment	Each shipment must have certificate of compliance that includes: 1. Results for tests specified in Section 90-1.01D(6) of *Standard Specifications* 2. Certification that material was tested within 12 months before use

Notes:

1. Refer to California Test 125 for sampling procedures.

2. For initial testing, provide 100 lb of 1-1/2 in. x 3/4 in., 75 lb of 3/4 in. x No. 4, 75 lb of pea gravel, and 50 lb of sand. Use this material for California Test 202, 206, 207, 211, 213, 214, 217, 227 and 229.
3. Refer to California Test 539 for method of sampling fresh concrete.

Table 6-1.18. Materials Acceptance Sampling and Testing Requirements: Miscellaneous Materials (1 of 5)

Test	Test Method	Sample Size & Container Size	Sampling Location	Acceptance Test Frequency	Remarks
BARBED WIRE AND WIRE MESH FENCES (Section 80-2)					
Barbed Wire, various properties; must comply with *Standard Specifications* Section 80-2.02D	ASTM A121	1 yd length	Job site	As necessary for verification if quality is questionable	
BOLTS AND HARDWARE (Section 75)					
		2 samples each diameter		Each lot	Sample and test if not previously inspected at the source
CHAIN LINK FENCES (Section 80-3)					
Wire Mesh, various properties; must comply with *Standard Specifications* Section 80	ASTM A116, Class 1	2 ft width	Job site	Each lot for verification if quality is questionable	Certificate of compliance required for vinyl clad fencing
CONCRETE PIPE (Section 65)					
Compliance with specifications		Contact METS for instructions		Contact METS for instructions	Sample and test if not previously inspected at source
CONDUIT (Section 86-1.02B)					
Conduit, various properties; must comply with *Standard Specifications* Section 86-1.02B	See *Standard Specifi-cations* Section 86-1.02B	2 ft. long from center of length, 2 samples each size	Job site	As necessary for verification if quality is questionable	

Table 6-1.18. Materials Acceptance Sampling and Testing Requirements: Miscellaneous Materials (2 of 5)

Test	Test Method	Sample Size & Container Size	Sampling Location	Acceptance Test Frequency	Remarks
ELECTRICAL CONDUCTORS AND CABLES (Section 86-1.02F)					
Electrical conductors and cables, various properties; must comply with *Standard Specifications* Section 86-1.02F	See *Standard Specifications* Section 86	2 ft. long, include markings, 2 samples per gauge	Job site	Each lot for verification if quality is questionable	
EXPANSION JOINT FILLER					
Compliance with specifications		6 in. long, full width of sheet		Each 1,000 sq ft not less than 2 per shipment	
GEOSYNTHETICS (Section 96)					
Various properties; must comply with *Standard Specifications* Section 96	See *Standard Specifications* Section 96	1 piece, 3 ft x full width of roll	Job site	Each lot for verification if quality is questionable. See Remarks	Certificate of compliance required for each lot; unroll at least 1 circumference before sampling
PAINT (Section 91)					
Paint, various properties; must comply with *Standard Specifications* Section 91	See *Standard Specifications* Section 91	For miscellaneous painting, 1 qt (see Section 6-2 of this manual)	Job site	Each batch	If less than 20 gallons, testing not required and resident engineer must field release. Zinc-rich primer must be on the Authorized Materials List
PAVEMENT MARKERS (Section 81-3)					
Pavement Markers, various properties; must comply with *Standard Specifications* Section 81-3	See *Standard Specifications* Section 81-3	20 markers	Job site	As necessary for verification if quality is questionable	Each shipment must have certificate of compliance

Table 6-1.18. Materials Acceptance Sampling and Testing Requirements: Miscellaneous Materials (3 of 5)

Test	Test Method	Sample Size & Container Size	Sampling Location	Acceptance Test Frequency	Remarks
PERMEABLE MATERIALS: (Section 68-2.02F)					
Durability Index	California Test 229	50 lb	Stockpile	Before use	
Sieve Analysis	California Test 202	50 lb	Stockpile	Before use,1 every day	
PERMEABLE MATERIALS: Class 3 (Section 68-2.02F)					
Crushed Faces	California Test 205	50 lb	Stockpile	Before use	
PRESTRESSED TENDON GROUT (Section 50)					
Efflux time	California Test 541	One 6x12 in. cylinder mold can	From batch immediately after mixing for prequalification, thereafter from outlet end of tendon, storage tank, or both	At the start of each day's work, and thereafter 1 test per each 5% of ducts; see Remarks	Repeat acceptance tests whenever source of material is changed
RAISED BARS (PRECAST)					
Compliance with specifications		1 unit or full size bar		Each lot	Sample and test if not previously inspected at the source
REINFORCING STEEL (Section 52)					
Reinforcing Steel, various properties	See *Standard Specifi-cations* Section 52	2 samples, 30 in., except 40 in. for No. 14 and No. 18	Job site	As necessary for verification if quality is questionable	Each shipment must be accompanied by a certificate of compliance
SLOPE PROTECTION (Section 72)					
Size	N/A		Quarry or stockpile	As required for acceptance	Adequate size of slope protection documented by measuring or weighing the material
Apparent Specific Gravity	California Test 206	75 lb	Quarry or stockpile	Before use	

Table 6-1.18. Materials Acceptance Sampling and Testing Requirements: Miscellaneous Materials (4 of 5)

Test	Test Method	Sample Size & Container Size	Sampling Location	Acceptance Test Frequency	Remarks
SLOPE PROTECTION (Section 72) (Cont.)					
Absorption	California Test 206	75 lb	Quarry or stockpile	Before use	
Durability Index	California Test 229	75 lb	Quarry or stockpile	Before use	
STEEL PRODUCTS					
		Contact METS for instructions		Contact METS for instructions	
STRUCTURAL STEEL AND MISCELLANEOUS METAL (Sections 55 & 75)					
		2 samples, 30-in., cut parallel to direction of rolling		Each heat or melt or 10 tons or fraction	Sample and test if not previously inspected at the source
STRUCTURAL STEEL COATINGS (Section 59)					
Paint, various properties; must comply with *Standard Specifications* Section 59	See *Standard Specifi-cations* Section 59	For bridge or major structure, send an unopened 5-gal can	Job site	Each batch; see Remarks	Unused portion of 5-gal sample will be returned to job; see Section 6-2, "Acceptance of Manufactured or Fabricated Materials and Products," of this manual
WATERPROOFING MATERIALS (Section 54)					
Glass Fiber	ASTM D1668, Type 1	9 sq ft of asphalt saturated cotton fabric	Job site	1 sample from each lot	
Asphalt	ASTM D449	5 lb of asphalt	Job site	1 sample from each lot	
Primer	ASTM D41	1 qt of asphalt primer	Job site	1 sample from each lot	

Table 6-1.18. Materials Acceptance Sampling and Testing Requirements: Miscellaneous Materials (5 of 5)

Test	Test Method	Sample Size & Container Size	Sampling Location	Acceptance Test Frequency	Remarks
WELDED WIRE REINFORCEMENT (Section 52-1.02C)					
Welded Wire Reinforcing Steel, must comply with *Standard Specifi-cations* Section 52-1.02C	ASTM A 1064/A 1064M	9 sq ft	Job site	As necessary for verification if quality is questionable	Each shipment must be accompanied by a certificate of compliance