STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

# MANUAL CHANGE TRANSMITTAL		NO. **24-1**
TITLE: Department of Transportation *Construction Manual*	APPROVED BY:  Ramon Hopkins, Chief Division of Construction	DATE ISSUED: **2-16-2024**
SUBJECT AREA Sections 4-36, 4-39	ISSUING UNIT Division of Construction	
SUPERSEDES Sections 4-36 and 4-39 of December 2022	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 http://www.dot.ca.gov/hq/construc/constmanual/ 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 4-36, "Surfacing and Pavements—General"

Changes to 4-3603D added information on where to find training videos for HMA pavement smoothness adjustments.

Section 4-39, "Asphalt Concrete"

Changes to 4-3901D (1), 4-3903D (5), and 4-3904A (2) clarify when test results are outside specification limits on projects. Changes to 4-3903D (2) specifies how to pay for tack coat.

Chapter 4 Construction Details

Section 36 Surfacing and Pavements—General

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Section 36 Surfacing and Pavements—General

4-3601 General

Section 36, "General," of the *Standard Specifications* includes general requirements for sections within Division V, "Surfacings and Pavements" of the *Standard Specifications.*

This section provides general guidelines for preconstruction meetings and pavement smoothness. Refer to the sections listed in Table 4-36.1., "Additional Information for Surfacing and Pavements," of this manual.

Table 4-36.1. Additional Information for Surfacing and Pavements

Section Title	***Standard Specification* Section**	***Construction Manual* Section**
Seal Coats	37	4-37
Asphalt Concrete	39	4-39
Concrete Pavement	40	4-40
Existing Concrete Pavement	41	4-41
Groove and Grind Concrete	42	4-42

This section also includes inspection guidelines for base bond breaker that is applied between a base and concrete pavement.

4-3602 Before Work Begins

4-3602A Preconstruction Meetings

Hold a preconstruction meeting to discuss the surfacing and paving operation work a minimum of 3 business days before the start of the work. This meeting is specific to the surfacing or paving work and is not the same meeting as required in Section 8-1.03, "Preconstruction Conference," of the *Standard Specifications* and as described in Section 5-003, "Preconstruction Conference with the Contractor," of this manual. For preconstruction meetings under this section, discuss specifications and processes for producing materials and constructing the surfacing or pavement. Refer to Section 36-1.01D(2), "Preconstruction Meetings," of the *Standard Specifications* for a list of topics to include in the meeting. Review the applicable specification section for additional items that must be discussed in this preconstruction meeting.

Caltrans staff at this preconstruction meeting must include the resident engineer, principal assistants, material sampling and testing staff, and other key personnel.

Refer to Section 36-1.01D(2), "Preconstruction Meetings," of the *Standard Specifications* for the list of contractor personnel that are required to attend. Make sure the contractor also includes:

- For seal coats, the emulsion and binder suppliers
- For hot mix asphalt using a warm mix asphalt additive technology, the technical representative for the warm mix asphalt technology
- For individual slab replacement with rapid strength concrete, the concrete plant inspectors and personnel performing saw-cutting and joint sealing

Do not allow placement of the trial slabs, construction of test strips, or paving to start until the required personnel have attended the preconstruction meeting.

4-3602B Base Bond Breaker

Before work on the base bond breaker begins, do the following:

- Review the contractor's proposed base bond breaker to verify that it meets the requirements for the type of base it is being placed over.

4-3602C Pavement Smoothness

Before work begins, take the following steps:

- Set up an electronic file structure for the smoothness submittals. You will receive numerous files from various lanes. It is recommended to have at least one folder for each route and direction. The PPF, PVP and XLSM file names are long, so abbreviate the folder names to the extent possible. This allows the electronic smoothness submittals from the contractor to be organized and prevent exceeding maximum file path name warnings.
- At least 15 days before measuring pavement smoothness with an inertial profiler, contractors must register with the Caltrans' secure file transfer system. If contractors need to obtain information on the registration process, have them send an email request with their contact information to:
  - Asphalt.Smoothness@dot.ca.gov for asphalt
  - Concrete.Smoothness@dot.ca.gov for concrete surfaces
- Review Section 36-3.01D(3)(b)(i), "General," of the *Standard Specifications* and determine which portions of new pavement will be subject to inertial profiler requirements and which portions will be subject to straightedge requirements.
- Discuss pavement smoothness requirements at the preconstruction meeting for the surfacing or pavement operation. Include the following items in the discussion:
  - Requirements for the smoothness quality control plan.
  - Specified naming conventions on all submitted profiles. All bridge approach slabs, bridges, and culverts visible on the roadway surface and at grade intersections must be included in the raw inertial profile data.

- Contactor-marked locations of the beginning and ending stations and leave-outs in order for the engineer to verify final acceptance profiles.

Discuss that a written smoothness quality control plan must be submitted by the contractor to the resident engineer at or before the preconstruction meeting. The plan must incorporate the following elements:

1. Organization: Contact names, organizational chart, telephone numbers, current certifications, titles, roles, and the responsibilities of personnel monitoring smoothness, collecting profile data, submitting data, requesting pay adjustments and reports, and implementing corrective actions.
2. Inertial profiler and operator certification requirements: Inertial profiler certification issued by Caltrans within the past 12 months.
    a. Manufacturer's instructions and test procedures for calibration and verification of the inertial profiler
    b. Operator certification for the inertial profiler issued by Caltrans within the past 12 months
3. Schedule: The methods and timing used for monitoring and testing ride quality throughout the placement operation process. An indication of the approximate timing of acceptance testing for the profile operations defined in Section 36-3.01C (3), “Smoothness Corrective Grinding Plan,” of the *Standard Specifications,* in relation to placement operations and stages of construction.
4. Layout plan: Includes the following elements:
    a. Semi-permanent reference points at the beginning and end of the project based on the plans.
    b. For each profile run, define additional semipermanent reference points for the beginning and ending positions of each run.
    c. List the position and name of each semipermanent reference point. These reference points must be outside the traveled way, perpendicular to the starting position of each lane. Where starting positions are adjacent to each other but staggered, there must be separate starting positions. An example of this would be staggered starting positions caused by bridge abutment skew angles.
    d. The semi-permanent reference points used to establish the beginning position of a profile must be based on the EXIST profile run for HMA and grind existing concrete pavement, and the PAVE profile for new concrete pavement. This requires the EXIST profile to be run, semipermanent reference points marked and tied to the EXIST inertial profile distance measurement instrumentation (DMI) stationing before submitting the smoothness quality control plan. When the EXIST profile run delays the preconstruction meeting, the DMI stationing of the semipermanent reference points may be estimated, if the layout plan is updated after completing the EXIST profile run. The semipermanent reference points from the EXIST

profile must be labeled in the field and in the pavement profiles using the following naming convention:

XXX-D-L-STA-VAL

In which:

XXX = “Beg” for the beginning of each profile run, “End” for the end of each profile run, “ExB” for the beginning point of the areas excluded from inertial profiler testing, and “ExE” for the end point of the areas excluded from inertial profiler testing.

D = traffic direction: *NB*, *SB*, *WB*, or *EB.*

L = lane number from left to right in the direction of travel, such as “1,” “2,” or “3.”

STA= station to the nearest foot, such as 10+20. Do not use postmiles. For HMA and grind existing concrete plans, the station is based on the DMI reading from the EXIST inertial profile. For new concrete pavement, the station is based on the DMI reading from the PAVE profile.

VAL= use “INC” where the value of stationing in the pavement profile data file (*.PPF) will increase in the direction of travel. Use “DEC” where the absolute value of the stationing in the pavement profile data file (*.PPF) will decrease in the direction of travel.

Use the same label name regardless of the stage of the profile.

- For each semi-permanent reference point, include a KMZ file with:
  - Color photographs clearly displaying the physical label used to define the semi-permanent reference points.
  - Listing of GPS coordinates.
- Semi-permanent reference points, where possible, must be recorded by inertial profilers using electronic eye readings or reflectors.
- Within 12 hours or on the same day of completing smoothness measurement, the contractor is required to submit the raw profile data as a PPF file on an authorized data storage device, along with a coordinated video or images taken at intervals no greater than 52.8 feet for the existing and baseline profiles. Also, submit a hard copy or a PDF file listing the following:
  1. Profile data collection time and date
  2. Data collection software version used
  3. Sensor serial number
  4. Low- and high-pass filter used
  5. 0.1-mile mean roughness index (MRI) values
- Within 2 business days after each profiling, the contractor must submit the profile information to the engineer and to Caltrans’ file sharing system. Refer to Section

4-3603, “During the Course of Work,” of this manual for more specific details of what is required in each submittal.

- After submitting the profile information to Caltrans’ file sharing system, the contractor must also send a notification to the engineer and to:
  - Asphalt.Smoothness@dot.ca.gov for asphalt projects
  - Concrete.Smoothness@dot.ca.gov for concrete pavement projects.
- Failure to submit profile information within prescribed timeframes is subject to progress payment withholds specified in Section 9-1.16E(3), “Performance Failure Withholds,” of the *Standard Specifications*. Refer to Section 3-906F (2), “Performance Failure Withholds,” of this manual.
- All bridge approach slabs, bridges, and culverts visible on the roadway surface and at-grade intersections must be recorded in the raw inertial profile data.
- The contractor must mark beginning and ending stationing of contractor profiles so the engineer may verify final acceptance profiles. Lack of beginning and ending station markings on shoulders may delay the engineer’s validation profiles and acceptance.

4-3602D ProVAL Training

In advance of the contractor’s start of surfacing or paving operations, verify that project staff is trained and knowledgeable in the use of ProVAL computer software. ProVAL is used to view and analyze raw profile data, as well as to review and generate PDF reports. ProVAL is on Caltrans’ Approved Software List, and online training is available for Caltrans employees at:

https://maintenance.onramp.dot.ca.gov/paveprogram/pavement-smoothness

Step-by-step videos on the steps the contractor takes to complete the smoothness payment adjustment request are available at:

https://dot.ca.gov/programs/construction/pavement-smoothness

4-3603 During the Course of Work

4-3603A Base Bond Breaker

During the base bond breaker work, take the following steps:

- Make sure contractor submits a certificate of compliance for each shipment of base bond breaker material delivered.
- Make sure base material is free of any foreign and loose materials and the base is cured before base bond breaker is applied.
- Verify that the base bond breaker used is specified for the type of base it is covering.
- Verify that the base bond breaker is paved over within 72 hours of placing base bond breaker.

- Verify that the base bond breaker is applied in accordance with the specifications.

4-3603B Pavement Smoothness

During the pavement smoothness work, take the following steps:

Verify that the contractor plans and measures smoothness profiles based on the type of work using Table 4-36.2., “Profiles Needed by Smoothness.” These inertial profiles are required in accordance with the specification to determine acceptance and any payment adjustments.

Table 4-36.2. Profiles Needed by Smoothness

Profile	Asphalt Target 55 Percent Improvement	Concrete Target 60/67.5/75	Grind Existing Concrete Percent improvement
EXISTING	X		X
BASELINE	X		X
PAVE	X	X	
FINAL	X	X	X

For asphalt concrete pavement, smoothness measurements are required from the contractor for the following:

- Existing asphalt concrete surface before performing any work on the surface. The contractor must provide the engineer the result labeled as the "EXIST" inertial profiler data file and notify the engineer if the MRI results vary by more than 10 percent from the MRI information provided by Caltrans at the time of advertisement. For projects suspended longer than 30 days, the contractor must measure the smoothness of the existing surface that has not received an HMA overlay and provide the engineer the result labeled as "EXISTR" inertial profiler data file. The contractor will use the EXISTR profile as the EXIST profile.
- Existing pavement segments if structural repairs, such as remove and replace asphalt concrete or leveling courses, are made. The contractor must provide the engineer the result labeled as "BASELINE" inertial profiler data file.
- Pavement segments exclusive of an open-graded friction course (OGFC) on new HMA before performing any HMA smoothness corrections. The contractor must provide the engineer the result labeled as "PAVE" inertial profiler data file.
- Pavement segments exclusive of OGFC on new HMA after performing any HMA smoothness corrective work. The contractor must provide the engineer the results labeled as "FINAL" inertial profiler data file. If there is no corrective work in the segment, the contractor will use the "PAVE" inertial profiler data as the "FINAL" inertial profiler data.

- Pavement segments of OGFC before performing any OGFC smoothness correction. The contractor must profile the sections and provide the engineer the result labeled as "PAVE" inertial profiler data file.
- Pavement segments of OGFC after performing any OGFC smoothness corrective work. The contractor must provide the engineer the result labeled as "FINAL" inertial profiler data file. If no corrective work in the segment is performed, the contractor must use the "PAVE" inertial profiler data file as the "FINAL" inertial profiler data file.

For concrete pavement, smoothness measurements must be taken by the contractor during the following scenarios:

- For new concrete pavement, measure profile:
  - After placing concrete, but before performing any smoothness corrections to calculate pavement MRI. The contractor must provide the engineer the results labeled as "PAVE" inertial profiler data file.
  - After performing any smoothness correction to calculate final MRI. The contractor must provide the engineer the results labeled as "FINAL" inertial profiler data file. If there is no corrective work in the segment, the contractor will use the "PAVE" inertial profiler data as the "FINAL" inertial profiler data.
- For grinding existing pavement project type, measure profile:
  - Before any work is performed to calculate existing MRI. The contractor must provide the engineer the result labeled as the "EXIST" inertial profiler data file.
  - After any work is performed but before grinding to calculate baseline MRI. This profile is required for informational purposes only. The contractor must provide the engineer the result labeled as "BASELINE" inertial profiler data file.
  - After the contractor's grinding achieves 60 MRI or 40 percent improvement, calculate final MRI. The contractor must provide the engineer the results labeled as "FINAL" inertial profiler data file.
- Verify that the inertial profiler displays a current certification. Both the left and right accelerometers must have a Caltrans-issued decal indicating the date the certification expires.

Confirm that the inertial profiler operator has a current Caltrans-issued certificate for each model of inertial profiler operated. Verify that the certificate covers the model of the certified inertial profiler. The following website includes a current list of inertial profilers and operators:

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

Make sure the contractor marks the beginning and ending stations on the pavement shoulder. When stationing is covered by additional surfacing, pavement, or removed by cold planing, make sure markings are transferred to the next surface and display the same stationing. Before running verification tests, verify that the beginning and

ending stations are still clearly marked and that Caltrans' inertial profiler operator uses the same stationing as the contractor.

At locations requiring pavement smoothness testing using an inertial profiler:

- The engineer must witness inertial profiler calibration and verification tests including contractor inertial profile smoothness measurements.
- The contractor must notify the engineer at least 2 business days before performing calibration and verification testing of the inertial profiler.

Before each day of profiling and in the presence of the engineer:

- The contractor must conduct the following calibration and verification tests:
  1. Block test to verify the accuracy of the height sensor using California Test 387, "Method of Test for Operation, Calibration and Operator Certification of Inertial Profilers."
  2. Bounce test to verify the combined accuracy of the height sensor and accelerometer using California Test 387.
  3. Distance measurement instrument (DMI) to verify the accuracy of the distance measuring instrument using California Test 387.
  4. Manufacturer's recommended tests.

At least annually, the contractor must conduct a cross-correlation verification.

Caltrans inertial profile operators performing verification testing must also perform the block, bounce, and DMI test daily. To reduce variability between the contractor's and Caltrans' DMI readings, the Caltrans inertial profiler operator should use the same 528-foot test section the contractor used when performing the daily DMI test, but only after confirming the length of the contractor's 528-foot test section.

At locations requiring pavement smoothness testing using an inertial profiler:

- Make sure the contractor tests areas for smoothness using a 12-foot straightedge. After testing, check that the contractor submits a list of areas that require correction. Verify that each area is identified by size and location as required by the *Standard Specifications*.
- Confirm that a follow-up acceptance test with a straightedge is performed to verify that the contractor's list is complete. If the area was measured using an inertial profiler, consider using the ProVAL Rolling Straightedge module to help identify locations that should be manually checked with the straightedge.
- Verify that the contractor submits pavement smoothness data in compliance with the current pavement smoothness requirements.
- Contractors must submit an electronic copy of the raw profile data as a PPF file on an authorized data storage device within 12 hours or on the same day of completing smoothness measurement. The PPF file must be submitted with either a coordinated video or photographs taken at intervals no greater than 52.8

feet for the EXIST and BASELINE profiles. Contractors are also required to submit a printout or a PDF file listing the following:

- Profile data collection time and date
- Data collection software version used
- Sensor serial number
- Low- and high-pass filter used
- 0.1-MRI values

After a contractor submits the profile information to Caltrans' file sharing system, the contactor must also send a notification of their electronic submittal to the resident engineer and to either Asphalt.Smoothness@dot.ca.gov or Concrete.Smoothness@dot.ca.gov with the names of the files submitted.

For each surface subject to inertial profile smoothness requirements, the profile data information must include:

1. Raw profile data for each lane in PPF files.
2. ProVAL ride quality analysis report for the MRI of each lane in a PDF file. Report the following, using the ProVAL Ride Quality Fixed Interval MRI Report:
   a. Listing of MRI values for 0.1-mile segments or portions thereof.
   b. Input data including the specified MRI threshold and fixed segment length. The MRI threshold value shown in the report must correspond to the value that requires mandatory corrective action. The percent improvement MRI thresholds will vary, and these do not need to be shown in the report.
   c. Raw profile data name selections.
   d. Areas exempt from inertial profile smoothness requirements.
3. ProVAL ride quality analysis report for the international roughness index (IRI) of the left and right wheel paths of each lane in a PDF file. Report the following using the ProVAL ride quality continuous IRI report:
   a. Listing of areas of localized roughness (ALR)
   b. Input data including the specified ALR threshold and continuous segment length
   c. Raw profile data name selections
   d. Areas exempt from inertial profile smoothness
4. GPS data file for each lane. Submit the data file in GPS exchange file format, which has a suffix of *.GPX.
5. Manufacturer's recommended calibration and verification test results for the inertial profiler.
6. Inertial profiler's calibration and verification test results, including results for bounce, block, and the distance measurement instrument.

7. Completed pavement smoothness inertial profiler submittal record.

Require the contractor to submit the raw profile data in an unfiltered pavement profile standard (PPF) file format. Reject any files that do not use the following file naming convention:

YYYYMMDD_TTCCCRRR_EA_D_L_W_B_E_X_PT.EXT

Where:

YYYY = year

MM = month, leading zero

DD = day of the month, leading zero

TT = district, leading zero

CCC = county, 2- or 3-letter abbreviation

RRR = route number with no leading zeros

EA = contract number, excluding the district identification number, expressed as 6 characters

D = traffic direction: NB, SB, WB, or EB

L = lane number from left to right in the direction of travel

W = wheel path, L for left, R for right, or B for both

B = beginning station to the nearest foot, such as 10+20, or beginning postmile to the nearest hundredth, such as 25.06 with no leading zero

E = ending station to the nearest foot, such as 14+20, or ending postmile to the nearest hundredth, such as 28.06 with no leading zero

X = profile operation, EXIST for existing pavement, BASELINE for existing pavement after performing repairs, PAVE for after paving, and FINAL for completed pavement documentation of compliance

PT = type of pavement surface profiled, such as:

- Type A HMA (hot mix asphalt)
- RHMA-G (rubberized hot mix asphalt-gap graded)
- OGFC (open-graded friction course)
- JPCP (jointed plain concrete pavement)
- CRCP (continuously reinforced concrete pavement)

EXT = “PPF” for raw profile data file extension

Multiple inertial profiler data files should be compressed into a .ZIP file format and submitted using the file-naming convention TT_EA_X_YYYYMMDD.zip.

The contractor must submit a grinding plan as an informational submittal at least 2 business days before performing corrective grinding for areas that do not meet the smoothness requirements.

Review the smoothness corrective grinding plan to verify that only necessary grinding is performed for HMA pavement. The contractor may not grind into incentive pay for HMA pavement. The payment adjustment worksheet accounts for this automatically by analyzing the adjustments planned for the PAVE uncorrected surface and the FINAL corrected surface. A contractor must only develop grinds to address ALR and to reduce disincentives because of excessive MRI values for HMA pavement.

For concrete pavement, grinding into incentive pay is an option available to the contractor. Grinding must not reduce pavement thickness below minimums in section 40-1.01D(8)(c)(iv), "Thickness," of the *Standard Specifications*.

The corrective grinding plan must include:

1. Grinder make and model:
    a. Grinder wheelbase in feet, measured from the front centerline to the back centerline of the single wheel or tandem wheel spread.
    b. Grinder head position in feet, measured relative to the centerline of the front single wheel or the front tandem wheel spread.
2. Tandem wheel spreads in feet.
3. Tabular listing of the planned corrective grinding, including:
    a. Start and end locations in stationing to the nearest foot
    b. Width of grind, such as left half-lane, right-half lane, or full-width lane
    c. Corresponding grinder head depths to the nearest 0.01 inch
    d. Direction of grind such as forward, reverse, forward-forward, reverse-reverse, forward-reverse, or reverse-forward
4. Anticipated improvement in the MRI and ALR values.

After each inertial profiling by the contractor, verify that the inertial profiles and other required files for contract compliance, include but are not limited, to the following:

- PPF files and PDF report that are submitted on an electronic storage device and received within 12 hours or on the same day of completing the smoothness measurement.
- Submittals for EXIST and BASELINE profiles include a coordinated video or photographs taken at a minimum of 52.8 feet.
- File naming convention meets the specification requirement.
- Stationing conforms with smoothness quality control plan.
- Each PPF file is required to have a printout or PDF produced by the inertial profiler, not ProVAL. Check the following:

- Profile data collection time and date matches the date the engineer witnessed the profile.
- Data collection software version used matches that used during inertial profiler certification.
- Sensor serial number on the inertial profilers match those used during inertial profiler certification.
- Low- and high-pass filters are set to zero. If they are not, request a new printout. Low- and high-pass filters smooth out the profile, which can result in lower smoothness values and higher pay adjustments.
- 0.1-MRI values are listed. These MRI values are calculated by the profilers' software, not by ProVAL. The average of these numbers will be similar to the smoothness values entered into the profile summary worksheets submitted at a later date as part of the smoothness payment adjustment request submitted by the contractor.

Upon receipt of the contractor's inertial profiles proposed for acceptance, review the FINAL profile data file and the two ride-quality reports. Carefully review the submittals to confirm:

- All listed leave-outs meet the requirements for the contract.
- The ride-quality analysis report for IRI indicates no locations where short continuous roughness exceeds the established specification limit for ALR.

On the ride-quality analysis report for MRI, where 0.05-mile to 0.10-mile fixed increments are indicated, all MRI values must not exceed the maximum MRI noted in the contract. Partial fixed increments 0.00 to 0.05-miles in length are not required to meet an MRI threshold but are required to meet ALR threshold.

4-3603C Profile Verification

After reviewing the contractor's profiles proposed for acceptance, request that Caltrans' inertial profile be run. Include a copy of the contractor's raw data file. Before submitting the request, confirm the contractor's semi-permanent reference points for the beginning and ending stationing locations are still clearly visible as described in the smoothness quality control plan. Caltrans must use the same stationing and semi-permanent reference points for verification profiles. This allows both files to be simultaneously loaded in ProVAL and compared for differences.

Verification testing will be performed using Caltrans' inertial profiler. The engineer must notify the contractor of Caltrans' intention to perform verification testing:

- Acceptance test results will be used for incentive or disincentive payments if the contractor's overall MRI is within 10 percent of Caltrans' overall MRI from the same project length.
- If the acceptance test results are not considered acceptable, Caltrans' MRI values will be used in the calculation for incentive and disincentive payments for

that evaluated length. Caltrans will have 15 days to complete an evaluation of both profiler certifications.

- The contractor and the resident engineer must work together to resolve disputes regarding test result discrepancies in accordance with Section 36-3.01D(4)(b) "Profile Verification," of the *Standard Specifications*.
- Contractors must notify the resident engineer within 5 business days of receiving the verification test result if they intend to dispute it:
  - An independent third party will perform referee testing over the same project length. Before the third party participates in a dispute resolution, their profiler and operator must be certified under Caltrans' "Profiler Certification Program." The independent third party must have no previous direct involvement with this contract and no current direct involvement with the contractor. The MRI value closest to the independent third party's MRI value will be used to calculate incentive and disincentive payment. The party with the MRI value furthest from that of the independent third party's will pay for the referee testing.
- At locations not requiring pavement smoothness testing using an inertial profiler, pavement smoothness is determined using a 12-foot straightedge and must not vary from the lower edge of the straightedge by more than:
  - 0.01 foot when the straightedge is laid parallel with the traffic lane centerline.
  - 0.02 foot when the straightedge is laid perpendicular to the centerline and extends from edge to edge of a traffic lane.
  - 0.02 foot when the straightedge is laid within 24 feet of a pavement conform.
- The specifications require a physical check with a 12-foot straightedge to determine if the surface meets specification. The ProVAL software has a "rolling straightedge" module to assist with determining compliance and identify where to physically check locations with a 12-foot straightedge.

4-3603D Payment adjustment

The contractor must submit a payment adjustment spreadsheet with their data. The spreadsheet is available from:

https://dot.ca.gov/programs/construction/pavement-smoothness

The engineer uses this spreadsheet for payment purposes only after taking the following steps to verify that:

1. No MRI values are in the "must correct" range.
2. The contractor certified that all ALR issues were resolved.
3. The contractor's profiles used in the payment adjustment spreadsheet are aligned within tolerance.
4. The contractor's MRI data is directly from ProVAL.
5. Caltrans' verification profiles are within 10 percent of the contractor profiles.

6. The profiles used in the PVP are from the same PPF files received the day the profiles were run.

The front worksheet in the spreadsheet titled "PayAdj" will highlight locations that do not meet requirements. Noncompliant areas are noted in red on this worksheet; immediately reject the payment adjustment spreadsheet with a description of the issues.

After successfully verifying the payment adjustment spreadsheet, make the applicable payment adjustment in the Extra Work Billing System with a change order that encumbers the supplemental fund allotment for the smoothness adjustment incentives.

Training videos for the contractors on how to complete the HMA pavement smoothness payment adjustment spreadsheets, and training videos for the resident engineers on how to review and approve contractor submitted HMA pavement smoothness payment adjustment spreadsheets, are available at:

https://dot.ca.gov/programs/construction/pavement-smoothness/smoothness-adjustment-spreadsheet-training-videos

Resident engineers must submit the hot mix asphalt pavement or concrete pavement smoothness pay adjustment spreadsheet file used to determine acceptance and the applicable payment adjustments for each lane, as well as the accompanying ProVAL project data files.

Submit these files to the email address for hot mix asphalt pavement or concrete pavement within 10 business days of including the smoothness payment adjustment in the progress estimate. Submit the same files to the email address within 10 business days of approving a contractor's smoothness acceptance request for grinding existing concrete pavement.

For hot mix asphalt pavement, submit the files to:

Asphalt.Smoothness@dot.ca.gov

For concrete pavement, submit the files to:

Concrete.Smoothness@dot.ca.gov

If the contractor's test results are not within 10 percent of the Caltrans' MRI value, the resident engineer and the contractor must attempt to resolve the differences. If the parties cannot agree, the specifications require using Caltrans' MRI values to determine the applicable adjustment. If the contractor disputes Caltrans' MRI values, the contractor can follow steps in the dispute resolution process. The contractor's remaining profile values that do not have a corresponding engineer verification profile or are within 10 percent of the MRI will be used to calculate the incentive and disincentive payments.

Section 36-3.01D(4)(b), "Profile Verification," of the *Standard Specifications* describes the dispute resolution process. This section requires independent third-party referee testing of the disputed sections of pavement. The MRI value used for the smoothness adjustment will be from the party whose mean MRI value is closer

to the independent third party's. The other party pays for the independent third-party testing.

If, after reviewing internally at Caltrans and reviewing with the contractor, the discrepancies are confirmed, the resident engineer must send a notice to the contractor of the discrepancies and Caltrans' intent to use its MRI values to calculate the incentive and disincentive.

The resident engineer is encouraged to request assistance from the district's smoothness expert and Headquarters Construction.

To assist in gathering pavement smoothness information and pavement smoothness data files, promote the use of data collection forms. Pavement smoothness forms are available at:

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

These forms include:

- Form CEM-3736, "Pavement Smoothness Inertial Profiler Submittal Record," is a checklist to review the completeness of submittals of inertial profiler data files, reports, and calibration information. This form should be used for both HMA and concrete pavements.
- Forms CEM-3736AC, "Asphalt Concrete Pavement Smoothness Corrections Information," and CEM-3736C, "Concrete Pavement Smoothness Corrections Information," provide information on pavement smoothness corrections made by contractors. The information collected on these forms will be used by Caltrans to help determine if improvements to the Caltrans pavement smoothness specifications are required. These forms should be completed by the contractor and submitted to the resident engineer and the appropriate pavement smoothness email address.

For hot mix asphalt pavement, submit the forms to: Asphalt.Smoothness@dot.ca.gov

For concrete pavement, submit the forms to: Concrete.Smoothness@dot.ca.gov

4-3604 Level of Inspection

4-3604A Base Bond Breaker

- Benchmark inspection of the existing base material to verify it is free of any foreign or loose material, and base has fully cured before application of the base bond breaker.
- Intermittent inspection of the application of the base bond breaker to verify it meets the requirements

4-3604B Pavement Smoothness

- Intermittent inspection to assure inertial profiler and operator certifications are current.

- Intermittent inspection to assure beginning and ending stationing of inertial profiler runs are marked on the shoulder, and correctly transferred to subsequent lifts when necessary.
- Intermittent inspection of submitted inertial profile submittals to verify that they meet the contractual requirements.
- Benchmark inspection of contractor's final "corrected" inertial profiles to verify that they meet the requirements for pavement smoothness, including that they are within 10 percent of Caltrans' International Roughness Index values for each 0.1-mile section.

4-3605 Quality Control

4-3605A Base Bond Breaker

- Make sure contractor submits a certificate of compliance for each delivery of base bond breaker material.

4-3605B Pavement Smoothness

- Verify that contractor has current certifications for inertial profiler and its operator.

4-3606 Payment

4-3606A Base Bond Breaker

- Measure and pay for base bond breaker where shown on the plans. Do not include any quantity for overlap.
- If performance grade asphalt binder is used as a base bond breaker, determine its weight in accordance with the Section 92-1.04, "Payment," of the *Standard Specifications.* Make any adjustments in accordance with Section 9-1.07, "Payment Adjustments for Price Index Fluctuations," of the *Standard Specifications.* Do not include the weight of the asphalt binder used for base bond breaker in any other payment item.

4-3606B Pavement Smoothness

- Payment for pavement smoothness is included in bid item covering the pavement being placed. If the contractor fails to submit required pavement smoothness submittals within the specified time, withhold from the next progress payment in accordance with Section 9-1.16E(3), "Performance Failure Withholds," of the *Standard Specifications.*
- During each progress payment, estimate the cost to correct smoothness on final surfaces that were constructed during the previous estimate period and apply an equivalent reduction in the corresponding pavement item pay quantities for incomplete work.

Chapter 4 Construction Details

Section 39 Asphalt Concrete

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 27, "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 27		
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