Section 39 QC/QA STG Meeting

SRL – Fontana CA

Group Memory

July 30. 2015

**Desired STG Outcome: D**evelop biddable/buildable HMA specifications based on good economic and engineering judgement.

Yellow highlights = Latest comments
Blue highlights = Item has been resolved
Green Highlight = Item complete but waiting on action

## 39-4 QUALITY CONTROL/QUALITY ASSURANCE CONSTRUCTION PROCESS

### 39-4.01 GENERAL

Section 39-4 includes specifications for HMA produced and constructed under the Quality Control / Quality Assurance construction process.

The QC/QA construction process consists of:

1. Establishing, maintaining, and changing if needed a quality control system providing assurance the HMA complies with the specifications
2. Sampling and testing at specified intervals, or sublots, to demonstrate compliance and to control the process
3. Department sampling and testing at specified intervals to verify the testing process and HMA quality
4. Engineer using test results, statistical evaluation of verified quality control tests, and inspection to accept HMA for payment

A lot is a quantity of HMA. The Engineer designates a new lot when:

1. 20 sublots are complete
2. JMF changes
3. Production stops for more than 30 days

**1. IN: Production stops for more than 30 days**

(Feb 25, 2015) IN: Should we revise this requirement?

(Feb 28, 2015) CT: If you stop production for longer than 30 days, a production start-up evaluation is required.

(March 17, 2015) CT/IN: change “30” to “45”. Waiting to be changed in QC/QA specs.

**2. IN: Requirement to Run TSR and HWT within 30 days of mix verification**

(March 17, 2015) CT/IN: change “30” to “45”. Waiting to be changed in QC/QA specs.

Each lot consists of no more than 20 sublots. A sublot is 750 tons, except a quantity of HMA paved at day's end greater than 250 tons is a sublot. If a quantity of HMA paved at day's end is less than 250 tons, you may either make this quantity a sublot or include it in the previous sublot's test results for statistical evaluation.

## 39-4.02 CONTRACTOR QUALITY CONTROL

### 39-4.02A General

Use a composite quality factor, $QF_C$, and individual quality factors, $QF_{QCi}$, to control your process and evaluate the quality control program. For quality characteristics without quality factors, use your QC plan's action limits to control your process.

Control HMA quality including:

1. Materials
2. Proportioning
3. Spreading and compacting
4. Finished roadway surface

Develop, implement, and maintain a quality control program that includes:

1. Inspection
2. Sampling
3. Testing

### 39-4.02B Quality Control Plan

With the JMF submittal, submit a QC plan. The QC plan must comply with the Department's *Quality Control Manual for Hot Mix Asphalt Production and Placement*. Discuss the QC plan with the Engineer during the prepaving conference.

The Engineer reviews each QC plan within 5 business days from the submittal. Do not produce HMA until the Engineer authorizes the QC plan.

The QC plan must include the name and qualifications of a QC manager. The QC manager administers the QC plan and during paving must be at the job site within 3 hours of receiving notice. The QC manager must not be any of the following on the project:

**3. IN: The QC plan must include the name and qualifications of a QC manager. The QC manager administers the QC plan and during paving must be at the job site within 3 hours of receiving notice. The QC manager must not be any of the following on the project:**

(Feb 25, 2015) IN: Can we have a QC Manager have a designated assistant? Let's look at having two sets of requirements for "standard" and QC/QA.

(Feb 28, 2015) CT: Is designated qualified and authorized to perform QC Manager's functions as described in the QC/QA manual?

(March 17, 2015) CT/IN: List alternate in the QC Plan. Alternate must "qualified and authorized to perform QC Manager's functions as described in the QC/QA manual".

~~(March 17, 2015) IN: One guy on the field one guy in the plant for projects greater than 2000 tons. Must follows new (to be created) current section 39's QC manual.~~

~~(April17, 2015) CT/IN: This is for the Section 39 committee.~~

(Jun 18, 2015) CT/IN: We need to make sure this item is addressed when QC/QA manual is revised. Waiting to work on QC/QA Manual

1. Foreman
2. Production or paving crewmember
3. Inspector
4. Tester

The QC plan must include action limits and details of corrective action you will take if a test result for any quality characteristic falls outside an action limit.

As work progresses, you must submit a QC plan supplement to change quality control procedures, personnel, tester qualification status, or laboratory accreditation status.

**39-4.02C Quality Control Inspection, Sampling, and Testing**

Sample, test, inspect, and manage HMA quality control.

Provide a roadway inspector while HMA paving activities are in progress. Provide a plant inspector during HMA production.

Inspectors must comply with the Department's *Quality Control Manual for Hot Mix Asphalt Production and Placement*.

Provide a testing laboratory and personnel for quality control testing. Provide the Engineer unrestricted access to the quality control activities. Before providing services for the project, the Engineer reviews, accredits, and qualifies the testing laboratory and personnel under the Department's Independent Assurance Program.

For HMA at production start-up and every 5,000 tons, sample and test under California Test 371. Submit the test results to the Engineer and to:

Moisture_Tests@dot.ca.gov

For HMA at production start-up and once during production, submit samples split from your HMA production sample for California Test 371 to the Engineer and the Transportation Laboratory, Attention: Moisture Test.

The Department does not use results from California Test 371 to determine specification compliance.

4. **IN: For HMA at production start-up and every 5,000 tons, sample and test under California Test 371 (AASHTO T 283) submit the test results to the Engineer and to:**

(Jun 18, 2015) CT: The Department has replaced CT 371 with AASHTO T 283 for moisture test.

(Feb 25, 2015) IN: Should TSR be removed?

(Feb 28, 2015) CT: Yes. Modify to AASHTO T 283 for spec compliance.

(Feb 28, 2015) CT: Test frequency for Hamburg and moisture should be every 10,000 tons

**5. IN: We need to review 283 data to determine the need for continued use of CT 371.**

(Feb 28, 2015) CT: Audrie is tracking all Superpave projects. We can look at those available test results.

(March 17, 2015): CT/IN: Continue to monitor Hamburg and T 283. Continue to collect enough data/info to make a decision.

(April 17, 2015) CT: Venkata will look at TSR and HWT data to see if there is a need for continued requirement for AASHTO T 283. Will try to report back by next meeting.

(May 27, 2015) CT: Don't have sufficient data/information to make a recommendation. Compare Hamburg versus TSR. All passed except one test where Hamburg passed and TSR failed (wet strength). Need to look at production data to verify the findings of the verification data.

(Jun 18, 2015) IN: We will wait to hear from Hamburg working group on July 1, 2015.

(July 30, 2015) Group is at an impasse due to a lack of data.

Comply with the values for the HMA quality characteristics and minimum random sampling and testing for quality control shown in the following table:

**Minimum Quality Control—QC/QA Construction Process**

| Quality characteristic | Test method | Minimum sampling and testing frequency | HMA Type | | | Location of sampling | Maxi-mum report-ing time allow-ance |
|---|---|---|---|---|---|---|---|
| | | | A | B | RHMA-G | | |
| Aggregate gradation[a] | California Test 202 | 1 per 750 tons | JMF ± tolerance [b] | JMF ± tolerance [b] | JMF ± tolerance [b] | California Test 125 | 24 hours |
| Asphalt binder content (%) | California Test 379 or 382 | | JMF ±0.45 | JMF ±0.45 | JMF ±0.50 | Loose mix behind paver See California Test 125 | |
| Percent of maximum theoretical density (%)[c,d] | QC plan | | 92–96 | 92–96 | 91–96 | QC plan | |
| Aggregate moisture content at continuous mixing plants and RAP moisture content at continuous mixing plants and batch mixing plants[e] | California Test 226 or 370 | 2 per day during production | -- | -- | -- | Stock-piles or cold feed belts | -- |
| Sand equivalent (min) [f] | California Test 217 | 1 per 750 tons | 47 | 42 | 47 | California Test 125 | 24 hours |
| HMA moisture content (%,max) | California Test 226 or 370 | 1 per 2,500 tons but not less than 1 per paving day | 1.0 | 1.0 | 1.0 | Loose Mix Behind Paver See California Test 125 | 24 hours |
| Stabilometer value (min)[f,g]<br><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings | California Test 366 | 1 per 4,000 tons or 2 per 5 business days, whichever is greater | 30<br><br>37 | 30<br><br>35 | --<br><br>23 | | 48 hours |
| Air void content (%)[f,h] | California Test 367 | | 4 ± 2 | 4 ± 2 | TV ± 2 | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Percent of crushed particles coarse aggregate (% min.):<br>One fractured face<br>Two fractured faces<br><br>Fine aggregate (% min) (Passing no. 4 sieve and retained on no. 8 sieve.):<br>One fractured face | California Test 205 | As designated in QC plan.<br><br>At least once per project. | 90<br>75<br><br>70 | 25<br>--<br><br>20 | --<br>90<br><br>70 | California Test 125 | 48 hours |
| Los Angeles Rattler (% max):<br>Loss at 100 rev.<br>Loss at 500 rev. | California Test 211 | | 12<br>45 | --<br>50 | 12<br>40 | California Test 125 | |
| Fine aggregate angularity (% min) | California Test 234 | | 45 | 45 | 45 | California Test 125 | |
| Flat and elongated particle (% max by weight @ 5:1) | California Test 235 | | Report only | Report only | Report only | California Test 125 | |
| Voids filled with asphalt (%) [i]:<br><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading | California Test 367 | | 76.0–80.0<br>73.0–76.0<br>65.0–75.0<br>65.0–75.0 | 76.0–80.0<br>73.0–76.0<br>65.0–75.0<br>65.0–75.0 | Report only | California Test 367 | |
| Voids in mineral aggregate (% min.) [i]:<br><br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading | California Test 367 | | 17.0<br>15.0<br>14.0<br>13.0 | 17.0<br>15.0<br>14.0<br>13.0 | --<br>--<br>18.0–23.0[j]<br>18.0–23.0[j] | California Test 367 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dust proportion [i]:<br><br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings | California Test 367 | | 0.9–2.0<br><br>0.6–1.3 | 0.9–2.0<br><br>0.6–1.3 | Report only | California Test 367 | |
| Smoothness | Section 39-1.12 | -- | 12-foot straight-edge, must-grind, and $PI_0$ | 12-foot straight-edge, must-grind, and $PI_0$ | 12-foot straight-edge, must-grind, and $PI_0$ | -- | |
| Asphalt rubber binder viscosity @ 350 °F, centipoises | Section 39-1.02D | -- | -- | -- | 1,500–4,000 | Section 39-1.02D | 24 hours |
| CRM | Section 39-1.02D | -- | -- | -- | Section 39-1.02D | Section 39-1.02D | 48 hours |

[a] Determine combined aggregate gradation containing RAP under California Test 367.
[b] The tolerances must comply with the allowable tolerances in section 39-1.02E.
[c] Required for HMA Type A, Type B, and RHMA-G if the specified paved thickness is at least 0.15 foot.
[d] Determine maximum theoretical density (California Test 309) at the frequency specified for test maximum density under California Test 375, Part 5 D.
[e] For adjusting the plant controller at the HMA plant.
[f] Report the average of 3 tests from a single split sample.
[g] California Test 304, Part 2.13.
[h] Determine the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.
[i] Report only if the adjustment for the asphalt binder content TV is less than or equal to ±0.3 percent from the OBC value submitted on a *Contractor Hot Mix Asphalt Design Data* form.
[j] Voids in mineral aggregate for RHMA-G must be within this range.

**6. CT/IN: We need to replace existing QC Table with superpave Section 39 and modify as necessary.**

(April 17, 2015) IN: Tony will insert current Section 39 Table for Type A and RHMA into this document

(April 20, 2015) IN: See attached testing tables for Method Standard and QC/QA process

(May 27, 2015) IN: Purpose of reviewing tables is to evaluate Superpave versus Hveem requirements.

**7. IN: Binder content specifications are lopsided**

(May 27, 2015) IN: Industry will confirm PWL specification are valid for lopsided specifications (binder content).

(Jun 18, 2015) IN: Industry is concerned with tighter tolerance band (-0.3; + 0.5) impact on pay factors. Industry has concern with the unbalance factor and would like to consider +/- 0.4.

(June 18 2015) ACTION ITEM: Pete will modify HMAPay to make an “info only” version for contractors to use to analyze the effects of unbalanced tolerances on the quality factor determined for binder content. Contractors will be able to export data from an existing version of HMAPay file (being used on a contract)

into the “info only” version to determine what the quality factor for binder content would have been if the project used the -0.3 and +0.5% binder tolerance.

(July 30 2015) Industry is split on issue. Some do not agree with methodology to increase binder content but will not contest issue.

**8. CT: Should QC/QA apply to BWC-G and OGFC?**

(Jun 18, 2015) Action Item: Industry will discuss and will get back to CT on this.

(July 30, 2015) IN: There should be pay factors on binder content and gradation to incentivize quality.

(July 30, 2015) CT: CT will get back to industry by next meeting on this.

**9. IN: OGFC cannot be sampled from the matt behind the paver**

(July 30, 2015) CT: CT will get back to industry by next meeting on this.

Within the specified reporting time, submit test results including:

1. Sampling location, quantity, and time
2. Testing results
3. Supporting data and calculations

If test results for any quality characteristic are beyond the action limits in the QC plan, take corrective actions. Document the corrective actions taken in the inspection records under section 39-4.02E.

Stop production, notify the Engineer, take corrective action, and demonstrate compliance with the specifications before resuming production and placement if:

1. A lot's composite quality factor, $QF_C$, or an individual quality factor, $QF_{QCi}$ for i = 3, 4, or 5, is below 0.90 determined under section 39-4.02F using quality control data
2. An individual quality factor, $QF_{QCi}$ for i = 1 or 2, is below 0.75 using quality control data
3. Quality characteristics for which a quality factor, $QF_{QCi}$, is not determined has 2 consecutive quality control tests not in compliance with the specifications

**10. IN: Stop production, notify the Engineer, take corrective action, and demonstrate compliance with the specifications before resuming production and placement if, How does Contractor demonstrate compliance?**

(Feb 25, 20150 IN: May require hot drop or production start-up. Is this problematic?

(Feb 28, 2015) CT: What is the purpose of continuing production when materials are clearly failing?.

(March 17, 2015) ACTION ITEM: Al Ochoa and Tim Denlay to propose alternative language.

(April 17, 2015) Industry proposal: Allow 750 tons of production or hot drop to demonstrate compliance.

(April 17, 2015) ACTION ITEM: Kee will consider proposal and get back to industry by next meeting.

(May 27, 2015) CT: “Stop production, notify the Engineer, take corrective action, and demonstrate compliance with the specifications before resuming production and placement.” will remain in the specs

IN: Provide a second option for the Engineer to choose.

Engineer review documented corrective actions, Engineer determine the corrective actions are "reasonable" move to production start-up evaluation.

CT, "If production start-up evaluation fails, materials is removed."

~~(May 27, 2015) Industry proposal: The Engineer reviews the documented corrective actions. The Engineer determines if the corrective actions are reasonable. The Engineer determines if the contractor moves to production start-up or resume normal production. If production fails the engineer evaluates the material and determines acceptance which may result in removal. (wordsmith?)~~

(May 27, 2015) IN: Engineer review documented corrective actions, Engineer determine the corrective actions are "reasonable" move to production start-up evaluation or resume normal production. If production start-up evaluation fails, materials is subject to removal.

(Jun 18, 2015) IN: Industry position reiterated that it should say "subject to removal" as opposed to "shall be removed". Shall be removed does not allowed for an engineering decision.

(Jun 18, 2015) ACTION ITEM: CT will discuss internally ("subject to removal" vs "shall be removed") and report back at next meeting.

(July 30, 2015) CT. CT will not consider the industry's proposed option (see IN June 18 comment above)

(July 30, 2015) Industry does not feel this is a viable solution but will agree to disagree and move on.

**39-4.02D Charts and Records**

Record sampling and testing results for quality control on forms provided in the *Quality Control Manual for Hot Mix Asphalt Production and Placement*, or on forms you submit with the QC plan. The QC plan must also include posting locations and submittal times for forms.

**11. IN: Submit quality control test results using the Department's statistical evaluation program, HMAPay. For HMAPay, go to the Department's Construction Web site.**

(Feb 25, 2015) IN: For ease of use and consistency consider specifying specific software to be provided by the contractor for use by Caltrans and Contractor. This requirement would be similar to the requirement to provide Primavera P6 software for all CT projects. Primavera is paid for as a lump sum bid item.

(March 17, 2015) ACTION ITEM: Tony to provide Primavera software language. (Done!!) Legal problem for CT? key language change from the first and second memo seems to be "or its equivalent"

(April 17, 2015) ACTION ITEM: CT will check to see if they can specify a specific HMA Pay software "or equivalent". Also, would the contractor be required to provide copy of software to CT?

(May 27, 2015) CT: Have to use "or equivalent"?

(May 27, 2015) IN: Industry will provide QC raw data in the format specified by CT to be used as HMA Pay input.

(Jun 18, 2015) CT: Software must be able to track QCqi after each test result is input

(July 30, 2015) CT/IN: Contractor can select software vendor provided data is transferable to HMA Pay. Turn item blue next meeting.

Submit quality control test results using the Department's statistical evaluation program, HMAPay. For HMAPay, go to the Department's Construction Web site.

**39-4.02E Records of Inspection and Testing**

During HMA production, submit a daily:

1. *HMA Construction Daily Record of Inspection*. Also make this record available at the HMA plant and job site each day.
2. *HMA Inspection and Testing Summary*. Include in the summary:
   2.1. QC worksheet with updated test results from the HMAPay program
   2.2. Test forms with the testers' signatures and QC manager's initials
   2.3. Inspection forms with the inspectors' signatures and QC manager's initials
   2.4. List and explanation of deviations from the specifications or regular practices
   2.5. Signed statement by the QC manager that says:

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

Retain for inspection the records generated as part of quality control, including inspection, sampling, and testing for at least 3 years after final acceptance.

**39-4.02F Statistical Evaluation**

**39-4.02F(1) General**

Determine a lot's composite quality factor, $QF_C$, and the individual quality factors, $QF_{QCi}$. Perform statistical evaluation calculations to determine these quality factors based on quality control test results for:

1. Aggregate gradation
2. Asphalt binder content
3. Percent of maximum theoretical density

**12. CT/IN: Do we want to add any other Quality Characteristics here? IRI Smoothness?**

(Feb 25, 2015) Industry comment: Should gradation become an action/suspension limit item and replaced with an air voids pay item?
(Feb 28, 2015) CT comment: CT is looking at keeping #200 (if not then DP)

(April 17, 2015) ACTION ITEM: Industry will discuss gradation requirements and make proposal)

(April 17, 2015) CT/IN: Incentive/Disincentive Smoothness will be discussed in Section 39 STG.

(May 27, 2015) ACTION ITEM: CT will provide comments by next Section 39 meeting (June 25th) in SRL

(Jun 18, 2015) CT: Ct wants Payfactor on #200 and (#4?)

(Jun 18, 2015) IN: Request CT to check with CT units to see if Section 39 is allowed to have Incentives/Disincentive for pavement smoothness. Where will the smoothness Incentives/Disincentives work be done? (Section 39, Section 39 QC/QA, Smoothness subtask group, or other?)

(July 30, 2015) CT" CT may want to consider some volumetric property(s). The group will revisit this item once the 375 max temperature issues has been resolved.

The Engineer grants a waiver and you must use 1.0 as the individual quality factor for percent of maximum theoretical density, $QF_{QC5}$, for HMA paved in:

1. Areas where the total paved thickness is less than 0.15 foot
2. Areas where the total paved thickness is less than 0.20 foot and 3/4-inch grading is specified and used
3. Dig outs
4. Leveling courses
5. Areas where compaction or compaction measurement by conventional methods is impeded

**13. IN: Should we wordsmith language to "areas where method specification for density is required"**

(Feb 28, 2015) CT comment: OE opposed "ambiguous" term ie: what are these area?

(April 17, 2015) This issue is complete

**39-4.02F(2) Statistical Evaluation Calculations**

Use the Variability-Unknown / Standard Deviation Method to determine the percentage of a lot not in compliance with the specifications.

Determine the percentage of work not in compliance with the specification limits for each quality characteristic as follows:

1. Calculate the arithmetic mean ( $\overline{X}$ ) of the test values

$$\overline{X} = \frac{\Sigma x}{n}$$

where:

*x* = individual test values
*n* = number of test values

2. Calculate the standard deviation

$$s = \sqrt{\frac{n\,(\Sigma x^2)-(\Sigma x)^2}{n(n-1)}}$$

where:

$\sum(x^2)$ = sum of the squares of individual test values
$(\sum x)^2$ = sum of the individual test values squared
*n* = number of test values

3. Calculate the upper quality index (Qu)

$$Q_u = \frac{USL - \overline{X}}{s}$$

where:

USL = TV plus the production tolerance or upper specification limit
s = standard deviation
$\overline{X}$ = arithmetic mean

4. Calculate the lower quality index (QL);

$$Q_L = \frac{\overline{X} - LSL}{s}$$

where:

LSL = TV minus production tolerance or lower specification limit
s = standard deviation
$\overline{X}$ = arithmetic mean

5. From the table, Upper Quality Index $Q_U$ or Lower Quality Index $Q_L$, determine $P_U$ ;

where:

$P_U$ = estimated percentage of work outside the USL
$P_U$ = 0, if USL is not specified

6. From the table, Upper Quality Index $Q_U$ or Lower Quality Index $Q_L$, determine $P_L$;

where:

$P_L$ = estimated percentage of work outside the LSL
$P_L$ = 0, if LSL is not specified

7. Calculate the total estimated percentage of work outside the USL and LSL, percent defective

Percent defective = PU + PL

The $P_U$ and $P_L$ are determined from the following:

| $P_U$ or $P_L$ | **Upper Quality Index $Q_U$ or Lower Quality Index $Q_L$** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample Size (n) | | | | | | | | | | | | |
| | 5 | 6 | 7 | 8 | 9 | 10-11 | 12-14 | 15-17 | 18-22 | 23-29 | 30-42 | 43-66 | >66 |
| 0 | 1.72 | 1.88 | 1.99 | 2.07 | 2.13 | 2.20 | 2.28 | 2.34 | 2.39 | 2.44 | 2.48 | 2.51 | 2.56 |
| 1 | 1.64 | 1.75 | 1.82 | 1.88 | 1.91 | 1.96 | 2.01 | 2.04 | 2.07 | 2.09 | 2.12 | 2.14 | 2.16 |
| 2 | 1.58 | 1.66 | 1.72 | 1.75 | 1.78 | 1.81 | 1.84 | 1.87 | 1.89 | 1.91 | 1.93 | 1.94 | 1.95 |
| 3 | 1.52 | 1.59 | 1.63 | 1.66 | 1.68 | 1.71 | 1.73 | 1.75 | 1.76 | 1.78 | 1.79 | 1.80 | 1.81 |
| 4 | 1.47 | 1.52 | 1.56 | 1.58 | 1.60 | 1.62 | 1.64 | 1.65 | 1.66 | 1.67 | 1.68 | 1.69 | 1.70 |
| 5 | 1.42 | 1.47 | 1.49 | 1.51 | 1.52 | 1.54 | 1.55 | 1.56 | 1.57 | 1.58 | 1.59 | 1.59 | 1.60 |
| 6 | 1.38 | 1.41 | 1.43 | 1.45 | 1.46 | 1.47 | 1.48 | 1.49 | 1.50 | 1.50 | 1.51 | 1.51 | 1.52 |
| 7 | 1.33 | 1.36 | 1.38 | 1.39 | 1.40 | 1.41 | 1.41 | 1.42 | 1.43 | 1.43 | 1.44 | 1.44 | 1.44 |
| 8 | 1.29 | 1.31 | 1.33 | 1.33 | 1.34 | 1.35 | 1.35 | 1.36 | 1.36 | 1.37 | 1.37 | 1.37 | 1.38 |
| 9 | 1.25 | 1.27 | 1.28 | 1.28 | 1.29 | 1.29 | 1.30 | 1.30 | 1.30 | 1.31 | 1.31 | 1.31 | 1.31 |
| 10 | 1.21 | 1.23 | 1.23 | 1.24 | 1.24 | 1.24 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.26 | 1.26 |
| 11 | 1.18 | 1.18 | 1.19 | 1.19 | 1.19 | 1.19 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 |
| 12 | 1.14 | 1.14 | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 |
| 13 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 | 1.11 |
| 14 | 1.07 | 1.07 | 1.07 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 | 1.06 |
| 15 | 1.03 | 1.03 | 1.03 | 1.03 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 |
| 16 | 1.00 | 0.99 | 0.99 | 0.99 | 0.99 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 | 0.98 |
| 17 | 0.97 | 0.96 | 0.95 | 0.95 | 0.95 | 0.95 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 | 0.94 |
| 18 | 0.93 | 0.92 | 0.92 | 0.92 | 0.91 | 0.91 | 0.91 | 0.91 | 0.90 | 0.90 | 0.90 | 0.90 | 0.90 |
| 19 | 0.90 | 0.89 | 0.88 | 0.88 | 0.88 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 | 0.87 |
| 20 | 0.87 | 0.86 | 0.85 | 0.85 | 0.84 | 0.84 | 0.84 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| 21 | 0.84 | 0.82 | 0.82 | 0.81 | 0.81 | 0.81 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.80 | 0.79 |
| 22 | 0.81 | 0.79 | 0.79 | 0.78 | 0.78 | 0.77 | 0.77 | 0.77 | 0.76 | 0.76 | 0.76 | 0.76 | 0.76 |
| 23 | 0.77 | 0.76 | 0.75 | 0.75 | 0.74 | 0.74 | 0.74 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 |
| 24 | 0.74 | 0.73 | 0.72 | 0.72 | 0.71 | 0.71 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 |
| 25 | 0.71 | 0.70 | 0.69 | 0.69 | 0.68 | 0.68 | 0.67 | 0.67 | 0.67 | 0.67 | 0.67 | 0.67 | 0.66 |
| 26 | 0.68 | 0.67 | 0.67 | 0.65 | 0.65 | 0.65 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.63 |
| 27 | 0.65 | 0.64 | 0.63 | 0.62 | 0.62 | 0.62 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.61 | 0.60 |
| 28 | 0.62 | 0.61 | 0.60 | 0.59 | 0.59 | 0.59 | 0.58 | 0.58 | 0.58 | 0.58 | 0.58 | 0.58 | 0.57 |
| 29 | 0.59 | 0.58 | 0.57 | 0.57 | 0.56 | 0.56 | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.54 |
| 30 | 0.56 | 0.55 | 0.54 | 0.54 | 0.53 | 0.53 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 |
| 31 | 0.53 | 0.52 | 0.51 | 0.51 | 0.50 | 0.50 | 0.50 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 | 0.49 |
| 32 | 0.50 | 0.49 | 0.48 | 0.48 | 0.48 | 0.47 | 0.47 | 0.47 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 |
| 33 | 0.47 | 0.48 | 0.45 | 0.45 | 0.45 | 0.44 | 0.44 | 0.44 | 0.44 | 0.43 | 0.43 | 0.43 | 0.43 |
| 34 | 0.45 | 0.43 | 0.43 | 0.42 | 0.42 | 0.42 | 0.41 | 0.41 | 0.41 | 0.41 | 0.41 | 0.41 | 0.40 |
| 35 | 0.42 | 0.40 | 0.40 | 0.39 | 0.39 | 0.39 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 | 0.38 |
| 36 | 0.39 | 0.38 | 0.37 | 0.37 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 | 0.36 |
| 37 | 0.36 | 0.35 | 0.34 | 0.34 | 0.34 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.32 |
| 38 | 0.33 | 0.32 | 0.32 | 0.31 | 0.31 | 0.31 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| 39 | 0.30 | 0.30 | 0.29 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 |
| 40 | 0.28 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| 41 | 0.25 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 | 0.23 |
| 42 | 0.23 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 |
| 43 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| 44 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| 45 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| 46 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| 47 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| 48 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| 49 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| 50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

NOTES:

1. If the value of $Q_U$ or $Q_L$ does not correspond to a value in the table, use the next lower value.

2. If $Q_U$ or $Q_L$ are negative values, $P_U$ or $P_L$ is equal to 100 minus the table value for $P_U$ or $P_L$.

**39-4.02F(3) Quality Factor Determination**

Determine individual quality factors, $QF_{QCi}$, using percent defective = $P_U + P_L$ and the following:

**Quality Factors**

| Quality factor | Maximum allowable percent defective ($P_U + P_L$) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sample size (n) | | | | | | | | | | | | |
| | 5 | 6 | 7 | 8 | 9 | 10-11 | 12-14 | 15-17 | 18-22 | 23-29 | 30-42 | 43-66 | >66 |
| 1.05 | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.04 | | | 0 | 1 | 3 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| 1.03 | | 0 | 2 | 4 | 6 | 8 | 7 | 7 | 6 | 5 | 5 | 4 | 4 |
| 1.02 | | 1 | 3 | 6 | 9 | 11 | 10 | 9 | 8 | 7 | 7 | 6 | 6 |
| 1.01 | 0 | 2 | 5 | 8 | 11 | 13 | 12 | 11 | 10 | 9 | 8 | 8 | 7 |
| 1.00 | 22 | 20 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| 0.99 | 24 | 22 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 11 | 10 | 9 |
| 0.98 | 26 | 24 | 22 | 21 | 20 | 19 | 18 | 16 | 15 | 14 | 13 | 12 | 10 |
| 0.97 | 28 | 26 | 24 | 23 | 22 | 21 | 19 | 18 | 17 | 16 | 14 | 13 | 12 |
| 0.96 | 30 | 28 | 26 | 25 | 24 | 22 | 21 | 19 | 18 | 17 | 16 | 14 | 13 |
| 0.95 | 32 | 29 | 28 | 26 | 25 | 24 | 22 | 21 | 20 | 18 | 17 | 16 | 14 |
| 0.94 | 33 | 31 | 29 | 28 | 27 | 25 | 24 | 22 | 21 | 20 | 18 | 17 | 15 |
| 0.93 | 35 | 33 | 31 | 29 | 28 | 27 | 25 | 24 | 22 | 21 | 20 | 18 | 16 |
| 0.92 | 37 | 34 | 32 | 31 | 30 | 28 | 27 | 25 | 24 | 22 | 21 | 19 | 18 |
| 0.91 | 38 | 36 | 34 | 32 | 31 | 30 | 28 | 26 | 25 | 24 | 22 | 21 | 19 |
| 0.90 | 39 | 37 | 35 | 34 | 33 | 31 | 29 | 28 | 26 | 25 | 23 | 22 | 20 |
| 0.89 | 41 | 38 | 37 | 35 | 34 | 32 | 31 | 29 | 28 | 26 | 25 | 23 | 21 |
| 0.88 | 42 | 40 | 38 | 36 | 35 | 34 | 32 | 30 | 29 | 27 | 26 | 24 | 22 |
| 0.87 | 43 | 41 | 39 | 38 | 37 | 35 | 33 | 32 | 30 | 29 | 27 | 25 | 23 |
| 0.86 | 45 | 42 | 41 | 39 | 38 | 36 | 34 | 33 | 31 | 30 | 28 | 26 | 24 |
| 0.85 | 46 | 44 | 42 | 40 | 39 | 38 | 36 | 34 | 33 | 31 | 29 | 28 | 25 |
| 0.84 | 47 | 45 | 43 | 42 | 40 | 39 | 37 | 35 | 34 | 32 | 30 | 29 | 27 |
| 0.83 | 49 | 46 | 44 | 43 | 42 | 40 | 38 | 36 | 35 | 33 | 31 | 30 | 28 |
| 0.82 | 50 | 47 | 46 | 44 | 43 | 41 | 39 | 38 | 36 | 34 | 33 | 31 | 29 |
| 0.81 | 51 | 49 | 47 | 45 | 44 | 42 | 41 | 39 | 37 | 36 | 34 | 32 | 30 |
| 0.80 | 52 | 50 | 48 | 46 | 45 | 44 | 42 | 40 | 38 | 37 | 35 | 33 | 31 |
| 0.79 | 54 | 51 | 49 | 48 | 46 | 45 | 43 | 41 | 39 | 38 | 36 | 34 | 32 |
| 0.78 | 55 | 52 | 50 | 49 | 48 | 46 | 44 | 42 | 41 | 39 | 37 | 35 | 33 |
| 0.77 | 56 | 54 | 52 | 50 | 49 | 47 | 45 | 43 | 42 | 40 | 38 | 36 | 34 |
| 0.76 | 57 | 55 | 53 | 51 | 50 | 48 | 46 | 44 | 43 | 41 | 39 | 37 | 35 |
| 0.75 | 58 | 56 | 54 | 52 | 51 | 49 | 47 | 46 | 44 | 42 | 40 | 38 | 36 |
| Reject | 60 | 57 | 55 | 53 | 52 | 51 | 48 | 47 | 45 | 43 | 41 | 40 | 37 |
| | 61 | 58 | 56 | 55 | 53 | 52 | 50 | 48 | 46 | 44 | 43 | 41 | 38 |
| | 62 | 59 | 57 | 56 | 54 | 53 | 51 | 49 | 47 | 45 | 44 | 42 | 39 |
| | 63 | 61 | 58 | 57 | 55 | 54 | 52 | 50 | 48 | 47 | 45 | 43 | 40 |
| | 64 | 62 | 60 | 58 | 57 | 55 | 53 | 51 | 49 | 48 | 46 | 44 | 41 |
| Reject values greater than those shown above | | | | | | | | | | | | | |

NOTE: To obtain a quality factor if the estimated percent outside specification limits from table titled, "Upper Quality Index $Q_U$ or Lower Quality Index $Q_L$," does not correspond to a value in the table, use the next larger value.

Compute the composite of single quality factors, $QF_C$, for a lot using:

$$QF_C = \sum_{i=1}^{5} w_i \, QF_{QC_i}$$

where:

| | |
|---|---|
| $QF_C$ = | the composite quality factor for the lot rounded to 2 decimal places |
| $QF_{QCi}$ = | the quality factor for the individual quality characteristic |
| w = | the weighting factor listed in the table titled "HMA Acceptance – QC/QA Construction Process" |
| *i* = | the quality characteristic index number in the table titled "HMA Acceptance – QC/QA Construction Process" |

**39-4.03 QUALITY ASSURANCE**

**39-4.03A General**

The Department assures quality by:

1. Reviewing mix designs and proposed JMF
2. Inspecting procedures
3. Conducting oversight of quality control inspection and records
4. Verification sampling and testing during production and paving

**39-4.03B Verification Sampling and Testing**

**39-4.03B(1) General**

The Department samples:

1. Aggregate to verify gradation
2. HMA to verify asphalt binder content

**14. IN: May need to add language to address smoothness or other Quality Characteristics**

(April 17, 2015) Smoothness will be handled in Section 39 STG.

(April 17, 2015) Group still open to looking at Pay Factor options (for QC/QA). No new ones identified to date.

(June 18, 2015) See other comments addressing smoothness and pay factors for other Quality Characteristics.

**39-4.03B(2) Verification**

For aggregate gradation and asphalt binder content, the ratio of verification testing frequency to the minimum quality control testing frequency is 1:5. The Department performs at least 3 verification tests per lot.

Using the t-test, the Engineer compares quality control tests results for aggregate gradation and asphalt binder content with corresponding verification test results. The Engineer uses the average and standard deviation of up to 20 sequential sublots for the comparison. The Engineer uses production start-up evaluation tests to represent the 1st sublot. If there are less than 20 sequential sublots, the Engineer uses the maximum number of sequential sublots available. The 21st sublot becomes the 1st sublot (n = 1) in the next lot.

The t-value for a group of test data is computed as follows:

$$t = \frac{\left|\overline{X}_c - \overline{X}_v\right|}{S_p\sqrt{\frac{1}{n_c} + \frac{1}{n_v}}} \quad \text{and} \quad S_p^2 = \frac{S_c^2(n_c - 1) + S_v^2(n_v - 1)}{n_c + n_v - 2}$$

where:

$n_c$ = Number of quality control tests (2 min, 20 max).
$n_v$ = Number of verification tests (min of 1 required).
$\overline{X}_c$ = Mean of quality control tests.
$\overline{X}_v$ = Mean of verification tests.
$S_p$ = Pooled standard deviation (when $n_v = 1$, $S_p = S_c$).
$S_c$ = Standard deviation of quality control tests.
$S_v$ = Standard deviation of verification tests (when $n_v > 1$).

The comparison of quality control test results and the verification test results is at a level of significance of α = 0.025. The Engineer computes t and compares it to the following critical t-values, $t_{crit}$:

**Critical T-Value**

| Degrees of freedom ($n_c$+$n_v$-2) | $t_{crit}$ (for $\alpha$ = 0.025) | Degrees of freedom ($n_c$+$n_v$-2) | $t_{crit}$ (for $\alpha$ = 0.025) |
|---|---|---|---|
| 1 | 24.452 | 18 | 2.445 |
| 2 | 6.205 | 19 | 2.433 |
| 3 | 4.177 | 20 | 2.423 |
| 4 | 3.495 | 21 | 2.414 |
| 5 | 3.163 | 22 | 2.405 |
| 6 | 2.969 | 23 | 2.398 |
| 7 | 2.841 | 24 | 2.391 |
| 8 | 2.752 | 25 | 2.385 |
| 9 | 2.685 | 26 | 2.379 |
| 10 | 2.634 | 27 | 2.373 |
| 11 | 2.593 | 28 | 2.368 |
| 12 | 2.560 | 29 | 2.364 |
| 13 | 2.533 | 30 | 2.360 |
| 14 | 2.510 | 40 | 2.329 |
| 15 | 2.490 | 60 | 2.299 |
| 16 | 2.473 | 120 | 2.270 |
| 17 | 2.458 | ∞ | 2.241 |

If the t-value computed is less than or equal to $t_{crit}$, quality control test results are verified.

If the t-value computed is greater than $t_{crit}$ and both $\overline{X}_v$ and $\overline{X}_c$ comply with acceptance specifications, the quality control tests are verified. You may continue to produce and place HMA with the following allowable differences:

1. $\left|\overline{X}_v - \overline{X}_c\right|$ ≤ 1.0 percent for any grading
2. $\left|\overline{X}_v - \overline{X}_c\right|$ ≤ 0.1 percent for asphalt binder content

If the t-value computed is greater than $t_{crit}$ and the $\left|\overline{X}_v - \overline{X}_c\right|$ for grading and asphalt binder content are greater than the allowable differences, quality control test results are not verified and:

1. Engineer notifies you.
2. You and the Engineer must investigate why the difference exists.
3. If the reason for the difference cannot be found and corrected, the Department's test results are used for acceptance and pay.

**15. IN: Should we include an option for the contractor to use the Engineers test results and pay factor rather than go into dispute resolution testing?**

(April 17, 2015) Kee: The t-test is ran on the finished lot.

(July 30, 2015) CT/IN does not want to invest the time to review this thought at this time. Turn this item blue next meeting.

**16. CT: CT should not share its QA results until the lot is completed.**

(Jun 18, 2015) IN: CT should provide Contractor QA test result in a timely mannered per FHWA Peer Review Team recommendation was (2 to 3 days).

ACTION ITEM: Tony to provide FHWA's contact and copy of FHWA Peer review Team recommendations to Kee and Pete

(July 30, 2015) IN: Industry feel question to should be re-phrased to ask: Can QA test results be shared with contractor before the lot is completed provided the QC test have been provided to engineer?

**39-4.04 ACCEPTANCE CRITERIA**

**39-4.04A Testing**

The Engineer samples for acceptance testing and tests for the following quality characteristics:

The Department determines the percent of maximum theoretical density from the average density of 3 density cores you take from every 750 tons of production or part thereof divided by the maximum theoretical density.

**17. CT: Should we combine QC and QA test results?**

(Feb 28, 2015) CT: FHWA is OK with using both QC and QA test results. FHWA require Engineer to verify QC test results first.

(July 30, 2015) CT/ IN: See item 15 above. Turn this item blue next meeting.

**HMA Acceptance—QC/QA Construction Process**

| Index (i) | Quality characteristic | | | | Weight-ing factor (w) | Test method | HMA type | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | A | B | RHMA-G |
| | | Aggregate gradation [a] | | | | | | | |
| | Sieve | 3/4" | 1/2" | 3/8" | | | | | |
| 1 | 1/2" | X [b] | -- | -- | 0.05 | California Test 202 | JMF ± Tolerance [c] | | |
| 1 | 3/8" | -- | X | -- | 0.05 | | | | |
| 1 | No. 4 | -- | -- | X | 0.05 | | | | |
| 2 | No. 8 | X | X | X | 0.10 | | | | |
| 3 | No. 200 | X | X | X | 0.15 | | | | |
| 4 | Asphalt binder content (%) | | | | 0.30 | California Test 379 or 382 | JMF ± 0.45 | JMF ± 0.45 | JMF ± 0.5 |
| 5 | Percent of maximum theoretical density (%) [d, e] | | | | 0.40 | California Test 375 | 92–96 | 92–96 | 91–96 |
| | Sand equivalent (min) [f] | | | | | California Test 217 | 47 | 42 | 47 |
| | Stabilometer value (min) [f,g]<br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings | | | | | California Test 366 | <br>30<br>37 | <br>30<br>35 | <br>--<br>23 |
| | Air void content (%)[f, h] | | | | | California Test 367 | 4 ± 2 | 4 ± 2 | TV ± 2 |
| | Percent of crushed particles coarse aggregate (% min)<br>One fractured face<br>Two fractured faces<br>Fine aggregate (% min)<br>(Passing No. 4 sieve and retained on No. 8 sieve.)<br>One fractured face | | | | | California Test 205 | <br><br>90<br>75<br><br><br><br>70 | <br><br>25<br>--<br><br><br><br>20 | <br><br>--<br>90<br><br><br><br>70 |
| | HMA moisture content (%, max) | | | | | California Test 226 or 370 | 1.0 | 1.0 | 1.0 |
| | Los Angeles Rattler (% max)<br>Loss at 100 rev.<br>Loss at 500 rev. | | | | | California Test 211 | <br><br>12<br>45 | <br><br>--<br>50 | <br><br>12<br>40 |
| | Fine aggregate angularity (% min) | | | | | California Test 234 | 45 | 45 | 45 |
| | Flat and elongated particle (% max by weight @ 5:1) | | | | | California Test 235 | Report only | Report only | Report only |
| | Voids in mineral aggregate (% min) [i]<br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading | | | | | California Test 367 | <br><br>17.0<br>15.0<br>14.0<br>13.0 | <br><br>17.0<br>15.0<br>14.0<br>13.0 | (Note j)<br><br>--<br>--<br>18.0–23.0<br>18.0–23.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Voids filled with asphalt (%) [i]<br>No. 4 grading<br>3/8" grading<br>1/2" grading<br>3/4" grading | | California Test 367 | 76.0–80.0<br>73.0–76.0<br>65.0–75.0<br>65.0–75.0 | 76.0–80.0<br>73.0–76.0<br>65.0–75.0<br>65.0–75.0 | Report only |
| | Dust proportion [i]<br>No. 4 and 3/8" gradings<br>1/2" and 3/4" gradings | | California Test 367 | 0.9–2.0<br>0.6–1.3 | 0.9–2.0<br>0.6–1.3 | Report only |
| | Smoothness | | Section 39-1.12 | 12-foot straight-edge, must grind, and $PI_0$ | 12-foot straight-edge, must grind, and $PI_0$ | 12-foot straight-edge, must grind, and $PI_0$ |
| | Asphalt binder | | Various | Section 92 | Section 92 | Section 92 |
| | Asphalt rubber binder | | Various | -- | -- | Section 92-1.01D(2) and section 39-1.02D |
| | Asphalt modifier | | Various | -- | -- | Section 39-1.02D |
| | CRM | | Various | -- | -- | Section 39-1.02D |

[a] The Engineer determines combined aggregate gradations containing RAP under California Test 367.
[b] "X" denotes the sieves the Engineer tests for the specified aggregate gradation.
[c] The tolerances must comply with the allowable tolerances in section 39-1.02E.
[d] The Engineer determines percent of maximum theoretical density if the specified total paved thickness is at least 0.15 foot under California Test 375 except the Engineer uses:

1. California Test 308, Method A, to determine in-place density of each density core instead of using the nuclear gauge in Part 4, "Determining In-Place Density By The Nuclear Density Device."
2. California Test 309 to determine maximum theoretical density instead of calculating test maximum density in Part 5, "Determining Test Maximum Density."

[e] The Engineer determines maximum theoretical density (California Test 309) at the frequency specified for Test Maximum Density under California Test 375, Part 5.D.
[f] The Engineer reports the average of 3 tests from a single split sample.
[g] California Test 304, Part 2.13.
[h] The Engineer determines the bulk specific gravity of each lab-compacted briquette under California Test 308, Method A, and theoretical maximum specific gravity under California Test 309.
[i] Report only if the adjustment for the asphalt binder content TV is less than or equal to ±0.3 percent from the OBC value submitted on a *Contractor Hot Mix Asphalt Design Data* form.
[j] Voids in mineral aggregate for RHMA-G must be within this range.

**18. IN: Replace Acceptance testing table with superpave Section 39 and modify as necessary**

~~(April 20, 2015) See attached testing tables for Method Standard and QC/QA process~~

(Aug 6, 2015) Table inserted for review

The Department determines the percent of maximum theoretical density from the average density of 3 density cores you take from every 750 tons of production or part thereof divided by the maximum theoretical density.

If the specified total paved thickness is at least 0.15 foot and any layer is less than 0.15 foot, the Department determines the percent of maximum theoretical density from density cores taken from the final layer measured the full depth of the total paved HMA thickness.

The Engineer calculates $QF_{QCi}$ for i = 1, 2, 3, and 4 using quality control data and $QF_{QCi}$ for i = 5 using quality assurance data,

The Engineer stops production and terminates a lot if:

1. A lot's composite quality factor, $QF_C$, or an individual quality factor, $QF_{QCi}$ for i = 3, 4, or 5, is below 0.90 determined under section 39-4.02F
2. An individual quality factor, $QF_{QCi}$ for i = 1 or 2, is below 0.75
3. Quality characteristics for which a quality factor, $QF_{QCi}$, is not determined has 2 consecutive acceptance or quality control test results not in compliance with the specifications

**19. IN: Should we remove the requirement to terminate the lot for item 3 above?**

(Feb 28, 2015) CT comment: Need to add "3 tests in one day" condition. Turn Blue?

For any single quality characteristic for which a quality factor, $QF_{QCi}$, is not determined, except smoothness, if 2 consecutive acceptance test results do not comply with specifications:

1. Stop production.
2. Take corrective action.
3. Take samples and split each sample into 4 parts in the Engineer's presence. Test 1 part for compliance with the specifications and submit 3 parts to the Engineer. The Department tests 1 part for compliance with the specifications and reserves and stores 2 parts.
4. Demonstrate compliance with the specifications before resuming production and placement.

**20. IN: Is the material subject to rejection or is the penalty the contractor having to stop work? If this occurred on a pay factor quality characteristic would the material be allowed to remain in place? What if this happened on HWT, it is a critical item but does not have a pay factor.**

(Feb 28, 2015) CT: Caltrans would treat these quality characteristics (where quality factor is not determined) exactly the same way they are treated in the "standard" Superpave Section 39. Turn Blue?

### 39-4.04B Statistical Evaluation, Determination of Quality Factors, and Acceptance

#### 39-4.04B(1) Statistical Evaluation and Determination of Quality Factors

To determine the individual quality factor, $QF_{QCi}$, for any quality factor i = 1 through 5 or a lot's composite quality factor, $QF_C$, for acceptance and payment adjustment, the Engineer uses the evaluation specifications under section 39-4.02F and the following:

1. Verified quality control test results for aggregate gradation
2. Verified quality control test results for asphalt binder content
3. Department's test results for percent of maximum theoretical density

#### 39-4.04B(2) Lot Acceptance Based on Quality Factors

The Engineer accepts a lot based on the quality factors determined for aggregate gradation and asphalt binder content, $QF_{QCi}$ for i = 1 through 4, using the total number of verified quality control test result values and the total percent defective ($P_U + P_L$).

The Engineer accepts a lot based on the quality factor determined for maximum theoretical density, $QF_{QC5}$, using the total number of test result values from cores and the total percent defective ($P_U + P_L$).

The Engineer calculates the quality factor for the lot, $QF_C$, which is a composite of weighted individual quality factors, $QF_{QCi}$, determined for each quality characteristic in the HMA Acceptance – QC/QA table in section 39-4.04A.

The Engineer accepts a lot based on quality factors if:

1. Current composite quality factor, $QF_C$, is 0.90 or greater
2. Each individual quality factor, $QF_{QCi}$ for i = 3, 4, and 5, is 0.90 or greater
3. Each individual quality factor, $QF_{QCi}$ for i = 1 and 2, is 0.75 or greater

No single quality characteristic test may represent more than 750 tons or 1 day's production, whichever is less.

**39-4.04B(3) Payment Adjustment**

If a lot is accepted, the Engineer adjusts payment with the following formula:

$$PA = \sum_{i=1}^{n} HMACP * wi * \left[QFQCi * (HMATT - WHMATTi) + WHMATTi\right] - \left(HMACP * HMATT\right)$$

where:

| | |
|---|---|
| PA = | payment adjustment rounded to 2 decimal places |
| *HMACP* = | HMA Contract price |
| *HMATT* = | HMA total tons represented in the lot |
| $WHMATT_i$ = | total tons of waived quality characteristic HMA |
| $QF_{QCi}$ = | running quality factor for the individual quality characteristic |
| | $QF_{QCi}$ for i = 1 through 4 must be from verified Contractor's QC results. $QF_{QC5}$ must be determined from the Engineer's results on density cores taken for percent of maximum theoretical density determination. |
| *w* = | weighting factor listed in the HMA acceptance table |
| *i* = | quality characteristic index number in the HMA acceptance table |

If the payment adjustment is a negative value, the Engineer deducts this amount from payment. If the payment adjustment is a positive value, the Engineer adds this amount to payment.

The 21st sublot becomes the 1st sublot (n = 1) in the next lot. If the 21st sequential sublot becomes the 1st sublot, the previous 20 sequential sublots become a lot for which the Engineer determines a quality factor. The Engineer uses this quality factor to pay for the HMA in the lot. If the next lot consists of less than 8 sublots, these sublots must be added to the previous lot for quality factor determination using 21 to 27 sublots.

**21. CT: Should we be using rolling 20?**

(Feb 28, 2015) Caltrans comment: No rolling if QFQC is used to determine pay for the lot. Rolling if QFQC is used to "stop production and terminate the lot." Turn Blue?

**22. Caltrans comment: After QC data verification should we combining QC and QA data for to determine pay factor**?

Feb 25, 2015) CT: Need to check with FHWA to see if this would be acceptable. Industry needs to weigh in on this as well.

(Feb 28, 2015) Caltrans comment: According to FHWA, verification of QC data is an essential component. Payment is dictated by the agency. Agency can elect to base 100% payment on QA test. Caltrans proposed combining QC and QA test data only if the data verified. If data does not verified, Caltrans would use only QA data.

(July 30, 2015) IN/CT agree combining test results is off the table at this time Turn this item blue next meeting.

**39-4.04C Dispute Resolution**

For a lot, if you or the Engineer dispute any quality factor, $QF_{QCi}$, or verification test result, every sublot in that lot must be retested.

Referee tests must be performed under the specifications for acceptance testing.

Any quality factor, $QF_{QCi}$, must be determined using the referee tests.

For any quality factor, $QF_{QCi}$, for i = 1 through 5, dispute resolution:

1. If the difference between the quality factors for $QF_{QCi}$ using the referee test result and the disputed test result is less than or equal to 0.01, the original test result is correct
2. If the difference between the quality factor for $QF_{QCi}$ using the referee test result and the disputed test result is more than 0.01, the quality factor determined from the referee tests supersedes the previously determined quality factor

**23. IN: We should consider adding requirements allowing the contractor to review the Engineers testing laboratory operations in an effort to resolve differences in test results at the lowest possible level.**

(Feb 28, 2015) CT comment: CT recommends that CT IA personnel review Contractor/Engineer testing in the presence of Engineer/Contractor.

(March 17, 2015) IN: Industry would like access to Engineer's lab to resolve difference in test results (prior to formal dispute).