SuperPave Industry Concerns Working List
As of July 25, 2013

Highlight in yellow = being worked on by the sub task group.

Highlight in Blue = issue addressed.

No highlight=no action on item yet.

Beginning with the April meeting, ISSUE-SPECIFIC ACTION ITEMS ARE INDICATED IN BOLD, WITH UNDERLINE.

Issue 1. New mix design when RAP Specific Gravity changes by > ± 0.06

Comment: (3/6/2013) This is being addressed by focus group.

(3/12/2013) CT is looking for data – they don't know what else is changed. CT wants industry bidders to try to make the value. Caltrans will provide language on this, asking for contractors to take action, modify their JMF. CT is trying to make sure contractors manage their stockpiles. (see upshot # 12)

Comment - (4/1/13) Industry would like data from Caltrans – make request at next Superpave STG meeting on 4/11/13.

(4/11/2013) CT has no data to show – They will show it when it becomes available.

(5/15/2013) Waiting for more data.

(6/18/2013) This will take a while – until we have data from contractors, we cannot proceed. Until we can see the difference in stockpiles we can work on this issue. CT is comfortable with the values until there are data to show otherwise. For 15% and below, do what you are doing right now. Intent is to force everyone to manage their stockpiles. **Caltrans has one project right now where they will be able to see what the differences are, and will report the data to the STG. Industry will track data from stockpile to stockpile and mix design to mix design, based on changes.**

(7-25-2013): Caltrans: When we have data we can look at this. Still looking for data.

Issue 2. VMA for ¾ and ½ inch mixes (13.5/14.5)

Comment: (3/6/2013) Industry is providing information based on the last meeting.

(3/12/2013) CT not seeing a problem with this. Problem is when Hveem mix design is put into a Superpave mix design. Data are limited. Industry is providing information and their position on this. The VMA requirements during JMF verification/production is -1+3.

Comment – (4/1/13) Delete VMA requirement for 1" HMA Type ~~A~~ C in Mix Design Table.

(4/11/2013) CT: re: "Delete VMA requirement for 1" HMA Type ~~A~~ C in Mix Design Table." **This will be resolved in the spec to match what is in the existing thype C SSP.**

Comment – (4/1/13) Need field data from pilot projects.

(4/11/2013) When data are sent out from CT the data are sanitized. CT will put data out within a week of receipt. This is updated weekly.

(4/11/2013) **Joe will add two columns to the Caltrans Data Sheet. (RAP specific grav, and Binder Content) Joe will re-send out the data sheet from mthe pilot projects.**

(6/18/2013) At this point CT has not seen any problems yet.

(7-25-2013): Still in wait and see mode. Caltrans not seeing a problem with 13.5. Somewhere between documents – word, PDF and web, something has shifted. **The spec posted on the CT METS Superpave website shows a shift of columns, making it look like it reads the wrong value for VMA. This is (or should be) being corrected.**

Issue 3. Dust Proportion for 3/8" mix (0.9 -2.0)

(3/12/2013) Industry will establish a focus group for this item. CT wants data and recommended tolerance.

Comment – (4/1/13) Want more information from Caltrans concerning the need for this requirement.

(4/11/2013) CT picked the range based on what other people are doing. CT says this is the best they could come up with. Please feel free to come back to CT with a better number. **Industry will survey its members and report at the May meeting, with a recommendation. Industry will send dust proportion data to Rita by 25 Apr 2013. Contact Audrie .Spears@dot.ca.gov and send her the data.**

(5/15/2013) e mail was sent out to get data – Industry is still waiting for data from contractors. CT is waiting for the data. CT is looking for any data on the 3/8" only mix. Superpave or otherwise. The more data industry provides, the better CT will be able to make the decision. CT says this 3/8 requirement is at the request of industry and a by-product of the 3:1. Industry says that issue here is that they are being told how to obtain the performance. **Contact Audrie .Spears@dot.ca.gov and send her the data**.

(6/18/2013) CT has not received any data yet. **Contact Audrie .Spears@dot.ca.gov and send her the data**. CT is looking for information on 3/8". CT will make a change when data show the need for a change. CT cannot answer the question about DPE until data are available. Superpave will mirror Section 39. **CT will change the Superpave spec dust proportion to ".6 to 1.2"** An electronic data base is not in the cards for METS at this time due to a lack of staff to do this. Meanwhile, the spread sheets will be sent out, and worksheets will be posted on the Superpave web page. **CT will send out the latest version of the Superpave spec.**

(7-25-2013): Caltrans reports this has been changed on the 0708 version. **Caltrans changed the Superpave spec dust proportion to ".6 to 1.3"**

Issue 4. QA Test Turn-around time should be same as QC test turnaround time

Comment : (3/6/2013) This is not within the scope for Rock Products.

Issue 5. To resolve dispute both QC and QA data should be reviewed. Initially by Engineer and Contractor and then ITP, if needed.

Comment : (3/6/2013) This is done. May be complete – will discuss in the larger group. Data sharing is already in the spec.

(3/12/2013) This is required already.

Issue 6. Minimum binder content of 7.5 (TWM) / 8.1 (DWA) may be a problem. Does Caltrans have data to support this change?

Comment : (3/6/2013) CT says they don't think this is an issue. Industry needs to provide data. Industry is working on this.

(3/12/2013) Industry in the process of collecting data to bring back to Caltrans

Comment – (4/1/13) See Industry document on data collection

Comment – (4/1/13) Caltrans needs to provide data to support changes. Industry ACT Co-chairs will address this with their Caltrans Task Group on April 9 2013.

(4/11/2013) Resolution pending receipt of data from UCPRC

(5/15/2013) Data from Superpave job is available. There will be a meeting between CT and UCPRC and Joe will report back.

(6/18/2013) UCPRC report is out. CT has data on a rubber job (close to 7.5 BTW). These same values are in Section 39. Data for a second project are on the way. CT reports both jobs have turned out beautifully. Problem is the wide variance even with PG 64-16 grading. Going to 70-10 is a harder binder than CT says it needs. Industry comment is dry strength being required for rubber that maybe the numbers are wrong, and there are no data showing failures**.** **Industry will provide data to CT, and we can follow up at the next meeting.** CT is looking at going away from ratios. CT advises that contractors need to look at the test data on the 64-16 before they commit. If the 64-16 is on the soft side, you are looking at potential failure. **CT understands this is an issue and will continue to look at it. In the short term, contractors need to look at binders – not one size fits all….**

(7-25-2013): Industry will send information to Joe Peterson on a project where they could not meet this. Any industry partners with data should send the data to Joe Peterson. Tony will verify successful mix. Caltrans says they may end up goinjg to a regional-based spec.

Issue 7. It is very difficult to screen RAP on a ¼" screen. Why is this required? Nearly all state fractionate on the ½" or 5/8" screen.

Concern: (3/12/2013) This is moved to RAP RAS group.

Issue 8. Section 39-1.01C(1): "Submit quality control test results within 2 days of request" This is a very tight time frame since AASHTO T283 takes longer than this to perform…If the test result is requested on the day of production this is impossible to meet. Also is this business days or regular days?

Comment : (3/12/13) Joe agrees with this and will make the adjustments to the specification. (see upshot # 13)

Resolution: Section 39-1.10(C)1 has been modified to "Submit all completed quality control test results within 2 days of a request. Submit all quality control tests within 7 days of a request."

22Mar13

Comment – need clarification. Want 7 business days for T283 & T324. Per plain language…is it "business days" or just "days?" Is this the same as issue # 31 (72 hours to 3 business days). Consider challenge if contractor must rely on 3rd party testing lab.

(4/11/2013) CT says this is 7 calendar days. Under plain language, "days" is calendar days.

Issue 9. Where is the data? Several projects have been put out on a 'pilot' basis. There are rumors that not all the criteria have been met and 'concessions' have been made. Information gathered on these projects need to be shared with industry and other Caltrans Districts.

Comment : (3/12/2013) CT and industry will both collect data.

Issue 10. Section 39-1.02M(4)(d) JMF Verification: Dust Proportion (DP) (design value +/- 0.5%). Not a good idea. Are we saying that if we have a DP design value of 1.1, then we will be allowed 0.6 to 1.6 during production? I'm not sure that's a good idea. Same thing on the low side of the range. EXAMPLE: Let's assume a mix design Pbe of 4.2%, a P200 of 4.7% and a corresponding DP of 1.1 So if the P200 were to increase to, say 6.0%, using the Pbe of 4.2%, DP would be 1.43. So a P200 delta of 1.3 would change the DP by 0.33. And a DP tolerance of +/- 0.5 would be a P200 range of ~2%. Though allowed in the gradation tolerance, it would be terrible for volumetrics. A more severe example would be a DP design value of 1.4 with an allowable tolerance of 0.9-1.9? I don't think so! Not many producers will want their P200 to be changing by 1.3% or more from mix design to production. Though we've seen the generation of large amounts of fines during production, we all know this is not a good practice. In addition, it will likely cause VMA to drop more than the allowable 1%. It should be sufficient for the DP to be within the design range of 0.7-1.4.

Comment: ~~Tony will edit this down, we will bring forward at next meeting. (see upshot # 14)~~ CT response: Unless otherwise specified, CT tolerances are based on the range.

Issue 11. Why are we adding Freeze Thaw requirement AASHTO T 283?

Comment: (3/6/2013) Industry and Caltrans were told this is a pilot. CT does not plan to remove this requirement for freeze-thaw.

Comment:

Issue 12. Requirement for T283 dry strength may be problematic for RHMA-G mixes or mix containing soft binders

Comment: (3/06/2013) Caltrans data does not show the 120 PSI strength as problematic. Industry is collecting data on this Issue.

(3/12/2013) Caltrans waiting for test results from industry. Goal is to get as many quality mixes through this as possible.

(4/8/11) Industry/Caltrans needs to run dry strength on successful RHMA-G (see issue No. 6)

(4/11/2013) There is no discussion at this time within CT to do away with T283. UC PRC research for the last year, and other multi year research suggests T283 be a very unreliable indication of moisture sensitivity for HMA, so why would this be more accurate for RHMA-G? T283 and other states' versions of this test are currently in use. **Caltrans and industry will collect data on this on an ongoing basis.**

(5/15/2013) Industry will continue to provide additional information. CT should dump T283 .

(6/18/2013) This is similar to one aspect of issue # 6.

(7-25-2013): Industry has an aggregate source that could not meet this dry strength of 120. CT says for lime slurry treated aggregate, they might drop to "100 psi on dry, and 70 psi as a minimum for wet." **Industry will survey their colleagues and see if this is acceptable.** 120 psi is still a concern for industry. There is no data to show this is a valid number. CT knows binders are different. CT is moving toward a true grade not just minimum value. Grading of binders has known issues and is beyond the scope of this sub task group.

Issue 13. Temperature for HWT 140 F.

Comment: (3/6/2013) AASHTO says temp for Hamburg wheel tracker is between is 50-70 C. Temperature was chosen because it is the temperature typically used. This is not a change.

(3/12/2013) Joe sent information from other states back to the co-chairs. CT says see what the data show. CT does not see any problems early on in this. Expectation is that you will have less than about 12 mm of rutting. More data are needed on Superpave across the board. CT will be double setting at 50 and 60 degrees C. Industry is encouraged to do this as well.

(4/11/2013) CT is looking at data from other states. When they get more information on this they will bring it back to the group.

(5/15/2013) CT is still looking. They run samples at both 50 and 60 to see what the difference is. CT and industry are still looking at this and adding data.

(6/18/2013) Industry will forward new data to CT including binder data, or will send a sample of the binder for CT to test. CT says known poor performers still pass Hamburg wheeltracker test at 50 degrees. CT looked at good performing mixes and they are borderline at 60 degrees. At 55 degrees poor performers are between 11 and 14 mm of rutting.

(7-25-2013): Caltrans would like more data. Caltrans runs samples at 50 and 55 degrees. **Industry will re-run the mix out of Vernalis and lower the liquid anti-strip to see what the resultant HWT number is. May also run the HWT with one PG grade lower.**

Issue 14. What is significance of the Asphalt Binder Set Point calculation? Is this different than mix design OBC? This calculation is unnecessary.

Comment : (3/6/2013) Industry: there is a bug in there that gives you 2/10 less oil than you are looking for. Industry will provide more information on this. Caltrans will look at this as well. This may not be needed.

(3/12/2013) Caltrans will take this out of the specification.

Issue 15. Is there a 5 day review and 20 day waiting period for an adjusted JMF after a failed verification?

Comment : (3/6/2013) CT: This is standard Spec language and the answer is "YES."

(3/12/2013) CT: Yes. This is intended to be identical to Section 39.

Issue 16. Fracture faces criteria (what is impact on available materials)

Comment : (3/6/2013) Industry will have to do a physical analysis to see if they meet the crush count to meet Superpave. If not, they will have to make an economic decision to make the capital investment to buy the equipment to meet this.

Issue17. Removing the word "consecutive" for QC quality characteristics test for 1 days production is counter to the FHWA peer review teams recommendations

Comment: (3/12/2013) CT: This is not a correct statement, problem is that CT can't find the words to properly express the intent. CT looking for collaboration with industry to fix this. Industry and CT will meet to discuss between meetings.(see upshot 15)

(4/11/2013) Joe will work with Rita to resolve this and report back at the May meeting.

Resolution The word consecutive has been added back in. Caltrans is only comfortable with this if the next paragraph in the specification remains .

(5/15/2013 Only the word "any" will be delete, otherwise the spec stays as follows:

For any quality characteristic except smoothness, if ~~any~~ 2 consecutive quality control test results for 1 day's production do not comply with the specifications:

1. Notify the Engineer
2. Take corrective action
3. Show how you will comply with the specifications before resuming production and placement on the State highway

For any quality characteristic except smoothness, if any 3 quality control test results for 1 day's production do not comply with the specifications:

1. Stop production
2. Notify the Engineer
3. Take corrective action
4. Show how you will comply with the specifications before resuming production and placement on the State highway

Issue 18. New language regarding 3 consecutive quality characteristics may be problematic

Comment : (3/6/2013) CT will work with co-chairs to re-work the language. Co-chairs will come up with the draft language.

Industry and CT will meet to discuss between meetings.(see upshot 15)

(4/11/2013) Joe will work with Rita to resolve this and report back at the May meeting.

Comment (JFP) See issue 17

Issue 19. Language regarding 2 consecutive quality tests, as it is written, production has been stopped and this is not the case. Bullet #3 should be removed or at least the wording "before resuming production and placement on the State highway"

Comment : (3/6/2013) This is related to Issue 10. See Issue 10.

Industry and CT will meet to discuss between meetings.(see upshot 15)

(4/11/2013) Joe will work with Rita to resolve this and report back at the May meeting.

Comment (JFP) See issue 17

Issue 20. In the table for Miscellaneous Minimum Quality Control, Do we really need to test Asphalt rubber binder viscosity for all OGFC? The table in 39-1.01D does not specify

Comment: (3/6/2013) Pending determination by larger group.

(3/12/2013) No one has a problem with this.`

Issue 21. Reference to AASHTO Certified Laboratory, are technicians required to be certified for viscosity test?

Comment : (3/6/2013) CT says yes, technicians will be performing an AASHTO test, so they must be tested and witnessed by CT IA. They will need to be attached to a lab or something. CT is working on the written test for a letter of proficiency for an AASHTO test.

(3/12/2013) For any portion of the superpave mix design, testers are required to be certified in that test, and the labs must be CT certified, AMRL accredited, and all techs need to be certified under the CT program, per CT IAP. For HMA, certification is not required for QC testers, but is strongly encouraged by CT. If viscosity test is a part of the contractor's QC the tester does not have to be certified.

Issue 22. Are satellite laboratories considered AASHTO accredited? Need guidance somewhere; QC/QA Manual?

Comment: (3/6/2013) Caltrans is not requiring small construction labs to be AMRL accredited. Industry concern: satellite labs at plants in the field cannot be accredited because there is not a full-time engineer in the trailer. CT will provide the guidance. Industry will discuss and review.

(3/12/2013) AMRL accreditation is required for labs doing mix design work. Satellite labs need to be CT certified, and meet the requirements of the CT IAP. CT will provide guidance defining what is a satellite lab.

Issue 23. Note 2 regarding RAP moisture not clear

Comment : (3/6/2013) More information needed from industry to clarify this question.

Comment : (3/6/2013) Caltrans is OK with this and is awaiting data from industry to show what the difficulty is, and what the majority of the other states are doing.

(3/12/2013) CT will reword this statement. 39-1.01D(7) number 2 at the bottom. (also .01D8)

Comment [R1]: This change should be in 39-1.-01D(8) as well.

22Mar13 – See comment in margin!

Resolution: Spec language changed to "Determine the aggregate moisture content in continuous mixing plants at least twice a day during production"

(4/11/2013) Caltrans will make the change by May mtg.

Resolution: Change made

Issue 24. Will Engineer be responsible for mixes containing too much binder when request to lower binder content is denied?

Comment : (3/6/2013) Industry will seek clarification from larger group. What is the intent of this question?

(3/12/2013) This has gone away in the Superpave spec.

Issue 25. Is cryogenically crumb rubber allowed?

Comment : (3/6/2013) CT: uh, never mind. ~~This is not allowed in the specification.~~

(3/12/2013) It has to be ambient ground

Issue 26. Can ether size fraction be used without the other? Can ether size fraction be used without the other?

Comment : (3/6/2013) With the pilot, both fractions must be used. The Superpave spec non-pilot percentages of fractionated RAP will be at the contractor's option.

(3/12/2013) For non-pilot, when RAP is greater than 15%, you must fractionate. There is no requirement to use both sizes, except with the pilot.

Issue 27. There needs to be a statement that both fractions shall be used at the percentages determined by the contractor equal to 25.0 ± 1.0 percent.

Comment : (3/6/2013) The language is clear in pilot projects. - contractor must use these percentages.

Issue 28. How is RAS being addressed for use in Superpave? Will RAS be allowed in Superpave?

Comment : (3/6/2013) This is not addressed in the Superpave currently, but it will be in the final spec. This is pending work by RAP/RAS sub task group.

Issue 29. Can batch weights be accumulative for RAP (and RAS when allowed) at batch Plants

Comment : (3/12/2013) Currently this is beyond the scope of this group. This is part of the MPQP.

Issue 30. Section 39-1.01B: "Final riding surface exclusive of OGFC" This would be clearer if the term OGFC matched what is written for the surface course definition above. Possibly change to "exclusive of HMA-O or RHMA-O" to match the surface course definition?

Comment : (3/12/2013) CT will clarify this language.

Resolution: Spec language changed to "**top layer:** Final riding surface exclusive of HMA-O or RHMA-O."

22Mar13

Comment – This is OK.

Issue 31. Section 39-1.01C(1): "For tests performed under AASHTO T324 (Modified) as specified in section 39-1.01D(1), submit test data and 1 tested sample set within 72 hours of sampling." Is this business hours or regular hours?

Comment : (3/12/2013) It is 72 regular hours. Caltrans will change this to "Three business days."

Resolution: Spec language changed to "For tests performed under AASHTO T324 (Modified) as specified in section 39-1.01D(1), submit test data and 1 tested sample set within 3 business days of sampling."

22Mar13 Resolution – see comment #8.

Issue 32. Section 39-1.01C(2)(b) On the chart for Air Voids Content: The test method is shown as AASHTO T 269 but on the CEM-3512SP it is shown as SP-2. These should match.

Comment : (3/12/2013) CT will investigate this and remedy it.

Resolution: CEM 3512SP has been changed from SP-2 to AASHTO T269

22Mar13

Comment – change has been made on CEM #3512SP. Verify that it has been posted on web site!!!

(4/11/2013) CT will update the web site. Check in in May meeting.

(5/15/2013 CT will update the web site, as soon as the new staff person is on board. Check in in the June meeting.

(6/18/2013) CT says web site will be up to date by the end of this month.

(7-25-2013): Caltrans reports that this has been posted.

Issue 33. Section 39-1.01C(2)(b) On the chart for Air Voids Content: Why are there values for $N_{initial}$ and N_{max}? This format is extremely confusing. The number of gyrations don't seem to apply to this section.

Comment : (3/12/2013) Industry will look at this again to validate that there is an issue. It may make sense as is. CT we will wait for the comment back from industry.

22Mar13 **Comment – Joe Peterson will insert the "@" symbol to eliminate confusion.**

4/11/2013 Joe will make the change and confirm in May mtg.

(5/15/2013) CT Comment: Upon further review if the @ sign is used it would signify that the air voids have to be at that value i.e. Ninitial@ 8.0 means at 8.0, The spec requires greater than 8.0 at Ninitial. CT does not want to put the @ sign in.

Issue 34. Section 39-1.01C(2)(b) On the chart for Gyration Compaction: "N_{max}=130" According to the N_{max} calculation in SP2, for the N_{des} of 85 the N_{max} should be 133 (with one decimal it is 132.5).

Comment : (3/12/2013) CT is using hard limits on gyrations, rounded.

Issue 35. Section 39-1.01C(2)(b) On the chart for Gyration Compaction: "N_{ini}=8" According to the N_{max} calculation in SP2, for the N_{des} of 85 the N_{ini} should be 7 (with one decimal it is 7.4).

Comment : (3/12/2013) CT is using hard limits on gyrations, rounded.

Issue 36. Section 39-1.01C(2)(b) On the chart for VMA: All of our other volumetrics are matched up with the typical Superpave specs (i.e. VFA, air voids, dust proportion, etc.) If our VMA is required to be higher we will not necessarily have the same success in results as the rest of the country that is using Superpave. Superpave specifies 13.0 for ¾", 14.0 for ½", and 15.0 for 3/8". Why are we not matching our VMA requirements with SP2?

Comment : (3/12/2013) CT not seeing a problem with this. Problem is when Hveem mix design is put into a Superpave mix design. Data are limited. Industry is providing information and their position on this. The VMA requirements during JMF verification/production is -1+3.

4/11/2013 This is ongoing. CT will lock at 13 if industry wants. **Joe will send clarification to the DME's on VMA requirement. May meeting report back.**

(5/15/2013) Comment (JFP) The VMA requirement of 13.5 is during mix design only. In verification and production the specified value is 12.5. This has been clarified to the DME's.

Issue 37. Section 39-1.01C(2)(b) On the chart for Hamburg Wheel Track, note c: "Test plant produced HMA" Since this chart is for mix design this requires the supplier to do a full mix design and run it through the plant prior to verification just to get test results for the Hamburg test. If there is fear of there being a difference between lab compacted and plant

produced this should be tested at the verification, not on plant produced material during the mix design phase.

Comment : (3/12/2013) CT encourages contactors to do this in the design phase. Include the cost of the verification in your unit price.

22Mar13 Requiring HWT (with plant-produced material) as part of JMF "verification" is onerous…expensive and time consuming. Why not use lab-produced material…like we do for all other tests…as part of the JMF submittal? If contractors consistently fail HWT during production, Industry is willing to revisit this proposal.

4/11/2013 Caltrans will provide guidance on splitting samples and running the JMF this way. Joe will coordinate with Al for presentation at the May meeting.

(5/15/2013) Joe will send out draft lab instruction language that reinforces what CT thinks is a good process. The time of 20 days will not change. CT will do what the spec says on plant-produced material. This is part of the verification process. Split samples would be too convoluted and too difficult to enforce. CT will encourage the districts to communicate with industry partners when the lab portion is all done. You would call the RE and coordinate splitting a hot drop sample – if you are happy with the results, you call the RE and say, "Yes, proceed with the verification." CT will not consider the mix design complete until they have the hot drop sample. The lab instruction will recommend to the districts that they do accept the 3511 and 3512 with the mix design submittal, less the hot drop verification. The acceptance/verification time does not start until the contractor notifies the RE to proceed with testing on the hot drop.

(6/18/2013) CT reports that intent is to put out a non-binding lab instruction. Industry comment is that this needs to be in the specification. It needs to be fixed. Industry needs consistency and would like to propose language for CTG to consider. This needs to be consistent. CT says that writing this into the spec language is more difficult than it looks. This is standard spec language in Section 39 and at this time, the spec language will not be changed. **Industry will prepare language for CT to consider.**

- (7-25-2013): Caltrans can run very low risk tests in the short term before the HWT and TSR results are in, to speed up the process. **Industry will re-write and resubmit their comments incorporating this discussion today into the spec and send it back to Joe.** Caltrans agrees with the statement in comment #2 below, that if contractor notifies Caltrans that HWT results has failed, the attempt should not counted as a failed JMF. re: comment #3 below, Caltrans says contractor would submit 3511 and 3512 without HWT and TSR results, and resubmit amended 3512 single page with the additional testing. There would not be two 3512's floating around.

July 13, 2013 (Industry/CT)

All

At the previous Rock Products Superpave STG meeting there was a lively discussion on JMF verification and the requirement that the Hamburg WT data provided in the contractors submittal be based on plant produced material. At the time it appeared that D-11 may have a more flexible approach that addresses the contractors concerns with cost of producing 50-100 tons of HMA for a single test. To try to ensure statewide consistency, Al Ochoa and Rita Leahy were

asked to draft some language that might be incorporated in the SP specifications. Please find the proposed language addressing this issue attached.

Please share your questions/comments with Pascal Mascarenhas and I and be prepared to discuss them at our upcoming Superpave STG meeting in Fontana.

Thank you,

Tony

D-11 approach for mix verification

- Caltrans has received everything (Materials & JMF from contractor (3511 & 3512) EXCEPT the HWT data.
- Caltrans does the following
  - Aggregate testing
  - Gradations
  - Calibration blanks for ignition oven
  - Testing hot drop for oil content
  - Compacting in gyratory to verify volumetric properties
- Caltrans does NOT “start clock” for mix verification until it receives passing HWT data from contractor
- A failure at any point in the process is treated as a JMF failure and would be processed accordingly.

Industry comments:

Comment 1:

I would add the following (in red).

D-11 approach for mix verification

- Caltrans has received everything (Materials & JMF from contractor (3511 & 3512) EXCEPT the HWT data.
- Upon receiving satisfactory HWT results from the contractor Caltrans does the following
  - Aggregate testing
  - Gradations
  - Calibration blanks for ignition oven
  - Testing hot drop for oil content
  - Compacting in gyratory to verify volumetric properties
- Caltrans does NOT “start clock” for mix verification until it receives passing HWT data from contractor

- A failure at any point in the process is treated as a JMF failure and would be processed accordingly.

Comment 2:

I would like to suggest one more minor addition to clarify the situation, that if contractor notify Caltrans that HWT results has failed, the attempt should not counted as a failed JMF.

Comment 3:

I'm curious about what this looks like on paper. Are the HWT results submitted via phone or email or would there be another official form for it? If you have to resubmit the JMF with the HWT results after the contractor has tested them I'm sure that having two JMFs floating around (1 with the HWT results and 1 without) will cause issues. Also, I would revise the wording Tony suggested as follows (in red)

D-11 approach for mix verification

- Caltrans has received everything (Materials & JMF from contractor (3511 & 3512) EXCEPT the HWT data.
- Upon receiving satisfactory HWT results from the contractor Caltrans does the following
  - Aggregate testing
  - Gradations
  - Calibration blanks for ignition oven
  - Testing hot drop for oil content
  - Compacting in gyratory to verify volumetric properties
- Caltrans does NOT "start clock" for mix verification until it receives passing HWT data from contractor
- A failure at any point in the process once satisfactory HWT results are received is treated as a JMF failure and would be processed accordingly. If the contractor does not pass HWT Caltrans will dispose of the materials submitted to them and the trial will not be considered a failure.

Comment 4:

The Superpave Specification on the project currently out for bid near Colusa also requires AASHTO T 283 test results from plant produced material in the mix design requirements.

Issue 38. Section 39-1.01C(2)(b) On the chart for Hamburg Wheel Track (inflection point minimum number of passes): it indicates that there is a footnote "f" however there is no footnote f below the table.

Comment :

Resolution: Spec Language changed, "f" deleted

22Mar13 – This has been done.

Issue 39. Section 39-1.01C(2)(c): "For each job site delivery of LAS" Is this supposed to mean delivery to the plant?

Comment : (4/11/2013) Yes, this means delivery to the plant.

Issue 40. Section 39-1.01C(2)(c) 1.5 under Batch Mixing: "of the dry aggregate weight" Everything else in the new specification is TWM, why is this TWA?

Comment :

Resolution: Spec Language changed to "1.5. Asphalt binder content as a percentage of the total weight of mix"
22Mar13 – This has been done.

Issue 41. Section 39-1.01C(2)(c) 2.8 under Continuous Mixing: "of the dry aggregate weight" same (as #6

Comment :

Resolution: Spec Language changed to: Asphalt binder content as percentage of the total weight of mix calculated from:
22Mar13 – This has been done.

Issue 42. Section 39-1.01D(1): "the engineer re-verifies the JMF if HMA production has stopped for longer than 30 days and the verified JMF is older than 12 months". The way this reads, as long as we are producing off of the verified JMF once every 30 days we do not have to re-verify, even if the JMF is older than 12 months.

Comment :

Resolution: Spec Language changed to "The Engineer reverifies the JMF if HMA production has stopped for longer than 30 days and the verified JMF is less than 12 months old." 22Mar13 – This has been done.

Issue 43. Section 39-1.01D(3): "3. HMA Plant Manager" Is it really necessary to have the plant manager present? In most cases it would be just as useful if not more useful to have the plant's QC manager, superintendent, foreman, or operator there. Maybe re-word to say plant operations representative?

Comment : (4/11/2013) CT says if this becomes a problem please bring it to Joe's attention. Whomever the RE is OK with would be OK with Joe. Industry would like it to say "Plant Representative."

Issue 44. Section 39-1.01D(4): the minimum sampling and testing frequency for agg moisture is 2 per day… if the day only consists of 200 tons this is extreme overkill. Revise to have specific tonnage as another option. This issue is also present in section 39-1.01D(6).

Comment :

Resolution: Spec Language changed to "1 per 1500 tons and any remaining part"

22Mar13

There is a conflict between the narrative in 39-1.01D(7) and (8) and the table shown in 39-1.01D(5) – Min QC Testing. In the table amend to "first 1500 tons."

(4/11/2013) Joe needs to amend the other section. Report in May.

Resolution:Language changed in 39-1.10D(7)

Issue 45. Section 39-1.02E: "Aggregate shaking time must not exceed 10 minutes for both course and fine aggregate portions" Determining how long to shake aggregate for in your mechanical shaker is part of the calibration process and AASHTO T27 requires you to continue sieving past 10minutes if the appropriate mass is not passing a sieve in a given time period in order to achieve adequate sieving. This requirement should be removed from section 39.

Comment : (4/11/2013) stopping in ten minutes falls in line with CTM202. CT moving to AASHTO and ASTM to the extent possible. CT expectation is that the IA people know this limitation.

Issue 46. Section 39-1.02J(1): "must have 25 ± 3 percent RAP", section 39-1.02F specifies that you must have 25 ±1 percent RAP. These should match.

Comment : This is only for the pilot projects.

Issue 47. Section 39-1.02J(4): "LAS must be from 0.5 to 1.0%" The last line of Section 39-1.01C(2)(b) specifies that you must use 0.5% LAS on RHMA-SP-G. Can we change one or the other to match each other?

Comment : Joe will make this change and report in May. Will change it to ".5 to 1%".

Resolution: Changed

Issue 48. If a contractor is lime treating aggregates they are required to perform AASHTO T 335, T 96, T 304 and ASTM D4791 will these tests be waived under 39-1.01D(4) Quality Control Testing during HMA production? Seems very redundant.

Comment : (5/15/2013) Lime-treatment will not change things – you always check your materials prior to lime treatment. This is covered in 39-1.02J(10.)

Issue 49. For the gauge bias it will be as per 375, 10 locations, 20 cores? I know that some testing firms only doing 5 to 10 cores. Will the density paperwork need to be submitted to Caltrans (CEM-3502 or equivalent)

Comment : (JFP) This is a QC test. Paperwork will only be submitted on CEM-3502 if requested by the engineer

Issue 50. Majority of producers/labs that have been polled that are looking at purchasing Superpave equipment that Caltrans has purchased to eliminate any future testing issues. This will lead us to the same position that we are in now – a single manufacturer that does not have the ability to upgrade and supply equipment.

Comment : (JFP)We do not specify equipment. CT has three types of wheel trackers, for example. Gyratory falls into a national standard. CT will only buy off-the-shelf equipment with all standard parts, etc.

Issue 51 round robin would help us understand both equipment and testing issues.

Comment : (5/15/2013) This is a good thing to do. This year's program is already established. CT is planning a round robin for 324 and 316 next year. In 2014 look for the Caltrans RSP to send materials out. Caltrans will work on this next year.

Issue 52. Superpave designed mixes end up with different asphalt contents. Does this mean that the millions of tons produced with the Hveem method were no designed properly. Are we really getting a better product.

Comment : (5/15/2013) We really hope so….

Issue 53. For RHMA the minimum AC% has been increased by 1%. Do we really want RHMA mixes with so much binder that there may be a stability, bleeding and rutting issue?

Comment : (5/15/2013) CT is collecting data to verify the mixes. High binder jobs have not shown this to be a problem. The data are limited.

Issue 54. Can one Caltrans person really drive the Superpave program and come up with the best program for the State?

Comment : Joe is the focal point, and it is a collective effort between Caltrans and Industry.

Issue 55. My primary concern is still with increasing the VMA from AI SP-2 requirements by half a percent and then requiring this to be met during production with a -1% +3 % requirement. We have difficulty meeting the VMA requirement today, when it is increased and then incorporated into production requirements, this will be a problem. The VFA for Caltrans Super Pave is identical to AI SP-2, why not follow the VMA guidelines, these two volumetric properties are very much related.

Comment : (5/15/2013) VMA is resolved. See the last comment for the VFA.

Issue 56. During the JMF verification the HMA Plant binder set point should not have to be at the OBC target. The Binder target during verification can remain the JMF OBC but allow the supplier to set the Plant as he sees fit to achieve the Binder target.

Comment : (5/15/2013) For Superpave this is done.

Issue 57. RHMA-SP-G: When the minimum target is raised from 7% of DWA to the new minimum of 7.5% of TWM this is a net increase of .9% binder. What positive goal is achieved by increasing the cost of the mix this dramatically? Volumetrics could be difficult to achieve at the higher binder content for ¾" mixes.

Comment : (5/15/2013) CT is aware of the increased cost associated with higher binder. Benefits and performance are expected to outweigh the cost.

Issue 58. Caltrans believes that the Hamburg inflection point and the TSR are not redundant tests. But he is wrong and the TSR should be eliminated with the adoption of the Hamburg inflection point testing.

Comment : (5/15/2013) CT considers each one of the tests unique and gives a measurement of different qualities. Industry comment: TSR results lack validity.

Issue 59. 4.9 *Authorized lime ratio for each aggregate size being treated.* Why have we changed to "Authorized" from Approved? It's still the contractor that is determining the exact lime proportions correct? Authorized makes it sound like we are being directed by Caltrans on what proportions to use

Comment : (5/15/2013) **CT will look at this – Spec 101 C(2)D should be the same language as in Section 39. This may be a plain language issue (2010 spec) and report back.**

(6/18/2013) CT confirms this is the same as the 2010 spec.

Issue 60. Under Hamburg Wheel-Track testing what is the benefit of measuring for impression every 100 passes as opposed to the 400 passes as per AASHTO T324? +

(6/18/2013) Electronic data gathering – this is a pilot and will probably eventually drop back to 400.

Issue 61. Why is there a requirement to notify the Engineer at least 2 business days in advance of sampling materials for QC testing?

(6/18/2013) This is the same language as in Section 39, and provides for necessary flexibility due to staffing.

Issue 62. I know this has nothing to do with Superpave but this was my Christmas wish out of the Sears Christmas catalog this year…Caltrans needs to start specifying WMA in RHMA for some of their Districts, not contractor's option. As most of the RHMA in District 4 is placed at night it would be in everyone's best interest to use a WMA technology in this cool, moist environment.

(6/18/2013) Comment noted by CT.

Issue 63. STOP SPECIFYING 1/2-INCH AGGREGATE WHEN PAVING 0.10 FT THICKNESS!!!!

(6/18/2013) This is already in the spec.

Issue 64. Is the Thickness Range table an Industry proposal? If not I guess Caltrans is in agreement that 1/2" should not be placed at a 0.10'.

(6/18/2013) This is already in the spec.

Issue 65. Why is the premix of asphalt binder and modifier now needed to be mixed for 20 minutes?

(6/18/2013) This is not new. This is existing language.

Issue 66. The tack coat on the vertical surface of a construction joint should be allowed to be omitted if new HMA is placed during the same shift (as allowed between HMA layers, bullet #2). If 2.1 and 2.2 are met.

(6/18/2013) This is an existing Section 39 requirement that carries over to Superpave.

Issue 67. Variability of the Hamburg Test

(6/18/2013) CT will be sending out mix later this year – will also include the air voids and the amount of material compacted, so you will be able to do a couple of test pucks, so we can narrow the variability down. CT will provide step-by –step procedures to maximize uniformity and consistency in methods. Components of Variability include everything from the material to the condition of the equipment

(7-25-2013): On hold – awaiting data.

Issue 68. Gyratory Compaction Temp – PM binders and Higher RAP mixes.

(6/18/2013) CT says binder supplier should provide viscosity/temperature curve. Go with the binder supplier's recommendation. **CT will look at language – using "supplier" rather than "producer." CT will look at AASHTO R26.** Industry wants to know what temperature to use for higher RAP mixes. What should it be? Additional work will be required for higher RAP/RAS mixes. **This will be referred to the RAP/RAS sub task group.**

Issue 69. The draft Superpave spec shows a gradation for 1" mixes but there are no design requirements listed for this mix.

22Mar13

Comment – Is the min VMA requirement (13.5%) for 1-inch Type A mix a typo? Should the min VMA requirement for a 1-inch Type C be dependent upon the NMAS - ¾-inch or 1-inch…13.5% or 14.5%?

Resolution: Spec Language changed, Type C mix has design requirements.

Issue 70. I thought we were going to be looking at a SuperPave specification, but it appears as though we are just changing from kneading compactor to gyratory. Using only one gyration level (125) and not looking at traffic levels to determine # of gyrations. We're also not evaluating volumetrics of 3 different blends and selecting the blend with the most favorable properties. I'm glad they've included Ninit & Nmax. As you all know, lower gyration levels on less heavily traveled roadways would produce higher VMA & correspondingly higher OBCs, and therefore a more durable pavement. With lower traffic & lighter loads, permanent deformation is less of a concern. Perhaps this specification (with some revisions) will be easier to implement and IS a place to start.

Issue 71. It will be interesting to see how VMA @ 125 gyrations compares to that at 150 kneading compaction tamps. Are the shear stresses exerted on HMA in the gyratory >, <, or = to the kneading compactor? Will VMA be more difficult to achieve?

(6/18/2013) The spec has been modified to lower the gyrations to 85.

Issue 72. Mandatory 25 +/- 1%? Perhaps ok for the few pilot projects, but I believe it should be contractor option and allow "up to" 25%, with guidelines on how to deal with the asphalt binder at the different RAP contents.

(6/18/2013) This has been changed to "up to 25%."

Issue 73. In Section 39.1.01C Submittals (page 2 of document): "Submit proportions for LAS as part of the JMF submittal. If you change the brand or type of LAS, submit a new JMF". NO!! Shouldn't be. **Since JMF is created without the LAS, a new JMF should not be necessary. Should only need to submit new AASHTO T283 & Hamburg test results using the new LAS.**

(6/18/2013) Caltrans will look into this issue and report back at the July meeting.

(7-25-2013): CT is still uncomfortable with this if you change the LAS. CT needs language for a single point verification at OBC. "Single point verification at the OBC." **CT will add language for the single point verification in the Superpave spec for LAS.**

Issue 74. AASHTO T283 every 10,000 tons during production. GOOD

(6/18/2013) Accepted without discussion.

Issue 75. AASHTO T324, Hamburg results within 48 hours of sampling, is not realistic, and perhaps not necessary.

(6/18/2013) This has been changed to seven days.

Issue 76. References to the SE test in Sections 39-1.01D(10)(h) Aggregate Lime Treat table & 39-1.01D(1)(i) QC Testing-Minimum QC table shown as AASHTO T166, should be T176. Check elsewhere.

(6/18/2013) Resolution: Spec language changed to reflect T 176 (92)

Whole different question about the LA Rattler. Lower LA Abrasion loss requirement - GOOD. Will there be aggregate sources excluded?

(6/13/2013) CT is holding this spec. The number right now is 40 at 500, in line with many other states. Some aggregate suppliers will have a challenge meeting the requirements.

22Mar13 This has been changed in section 39-1.01D(10)(h) and in the QC testing table…but was not highlighted in the QC table. CT to check this.

(7-25-2013): Industry will review this and get comments for the next meeting.

Issue 77. Semantics: Should be Theoretical Max Density, and not Maximum Theoretical Density. Is that too picky?

(6/18/2013) Yes, too picky.

Issue 78. Tighter Va tolerance of +/-1.5%?

(6/18/2013) Va has been changed to +/- 1.5. Data to date show that this is very reasonable but CT will be looking at this. CT has data on this making a better road.

(7-25-2013): CT still gathering data. Will continue to evaluate.

Issue 79. VMA requirement @ mix design, 0.5% higher, and during production 0.5% lower than previous. Are we saying that we will be allowed a 1% drop in VMA from mix design to production?

(6/18/2013) Yes – this is correct.

Issue 80. % of Theoretical Max Density shown as 92%-97% for QC, and 91%-97% for acceptance. Why? Either way, pay factor is determined based on Eng'r's cores. Shouldn't they be the same anyway?

(6/18/2013) Industry has a concern on this. CT says that some jobs are over-compacted, and that they rarely see above 92-93% in the field. If the mix is over-compacted it will/may bleed out on you. CT is not willing to drop the upper limit for compaction. This will be revisited when there is a QC/QA Spec. Everything now should read 92-97%. Industry says this is not a construction issue, it is a mix issue. If you don't compact the mix in construction, the traffic will compact it for you.

Issue 81. Is the minimum dry Indirect Tensile Strength requirement of 125psi for AASHTO T283 appropriate? I've seen numerous HMA mixes perform well at lower dry strengths, as long as the ratio is achieved. I believe a minimum strength is appropriate, but is 125psi the right value? Perhaps 100psi?

(6/18/2013) Dealt with in issue 12. This is on-going

Issue 82. Section 39-1.01D(2)(a) Engineer Acceptance - General: Does the Eng'r sample at the same location as the contractor (truck, behind paver)? Should they? i.e. if contractor takes his random QC samples from a truck at the plant, and the Eng'r behind the paver, is that acceptable? It appears to read that sampling from different locations could be done.

(6/18/2013) 125 allows many sampling points. CT is limited to the plant or behind the paver. This is the RE's call. CT would like to have everyone be limited to the plant or behind the paver. For now CT will leave this alone. Sampling locations should be worked out with the contractor. Caltrans is still discussing this internally. Caltrans must first ensure that everyone is sampling correctly. Then they need to specify the sampling location. Industry reports a logistics problem in that a splitter is required to split the samples.

Issue 83. Both the contractor & the Eng'r "prepare 3 briquettes for air voids & VMA determination". Are new Gsb performed? If not, which should be used to calculate VMA? And If so, we need to be mindful of the lack of precision in the determination of Gsb, especially for the fine portion of the test.

(6/18/2013) CT: No, new G_{sb} not required. Contractors will use 3512 SP, CT will use 3513 SP. Caltrans will proceed the same way that industry does at the plant. If contractors wash the fines, CT will also wash the fines. **Regarding fines: Industry will bring a proposal back to CT**.

(7-25-2013): Regarding Gsb: Industry will survey colleagues and bring a proposal back to CT. Ask "What frequency do the Contractors want themselves and Caltrans to run Gsb?" Need to have this done prior to the next meeting (8/14/2013). +

Issue 84. Must HMA comply with BOTH AASHTO T283 AND Hamburg?

(6/18/2013) CT says yes.

Issue 85. Section 39-1.02M(4)(d) JMF Verification: The air voids tolerance of +/-1.5% is perhaps ok, but needs to be discussed.

(6/18/201`3) See Issue 78.

Issue 86. ~~Section 39-1.02M(4)(d) JMF Verification: The VFA of Design value +/-1%, NO WAY. It should be sufficient for the VFA to be within the design range of 65-75%! We only need to consider a very simple example: assume mix design VMA of 14%, Va of 4.0% with resulting VFA of 71.4%. Now assume that during production VMA drops by a mere 0.5% to 13.5% & Va to 3.5%. The corresponding VFA would be 74.1%. An increase of 2.7% and out of the +/-1% tolerance. A second example: assume VMA increases slightly to 14.5% with Va staying right at 4% during production (perhaps an ideal mix), VFA would increase to 72.4% and be on the verge of being out of the +/-1% tolerance!~~

Comment :

22Mar13 (Frank Rancadore, Hongbin Xie & Rita Leahy will try to concisely articulate the issue. Will send to Tony Limas and Pascal Mascarenhas to share with Joe Peterson.)

Revised issue shown below:

VFA still appears everywhere in the spec as 65-75% for all mix types. As we've discussed on a couple of occasions, if VFA is going to be a requirement, i.e. NOT report only, the 65-75% limits are not appropriate for all mix types, especially the finer mix types. Since VMA, V_a, & VFA are interrelated, if the required VMA & V_a are achieved, VFA "is what it is".

As we know, VFA=100x(VMA-V_a)/VMA, so for an HMA mix designed at the MINIMUM VMA allowed for each mix type & at 4% voids, the corresponding VFA for 3/4", 1/2", 3/8", & 1/4" mixes would be 70.4, 72.4, **75.0**, & **77.8**% respectively. Since HMA mixes will most likely be designed with a higher-

than-the-minimum VMA, e.g. 1% above the minimum (or whatever), VFA will be higher yet. For example, if a 3/4" HMA is designed at 14.5% (13.5+1) VMA, a 1/2" at 15.5% (14.5+1), a 3/8" at 17% (16+1), & a 1/4" at 19% (18+1), VFA would then be 72.4, **74.4**, **76.5**, & **78.9** respectively. Though 3/8" & 1/4" mixes are not often used, on the occasions when they are, it would be impossible to meet the 65-75 VFA requirement. Since the lowest VMA for any mix will be 13.5% (@ design) for 3/4" HMA, the lowest VFA we'll see is ~70%. Production will be more complicated.

I believe Caltrans has said that this range comes right out of SP-2, but SP-2 gives ranges for VFA based on anticipated traffic levels (ESALs) and not mix types. At the higher traffic levels (>3 million ESALs), the 65-75% limits allowed agencies to select mixes with nominal maximum aggregate sizes up to 25mm (1") & 37.5mm (1 1/2") with minimum VMA requirements of 12 & 11 respectively, which at 4% voids yield VFAs on the lower side of the range (near 65%). And at the lower trafic levels, where finer mixes will most likely be selected, SP-2 allows VFA up to 78 (65-78) and 80 (70-80). All of these with VMA of 13, 14, & 15 for 3/4", 1/2", & 3/8" mixes.

(6/18/2013) CT is looking into this. At this time CT does not see a problem, but there are very limited data. Caltrans and industry will continue to collect volumetric data and see if there is a problem. Industry would like to investigate this, and consider the VFA criterion – do we want a range or an upper limit?

(7-25-2013): Industry will do calculations and report back in August at the next meeting. (Caltrans has set the VFA range to limit upper limit of VMA. They are limiting the upper end of the VMA via the VFA.)

From: Peterson, Joe F@DOT [mailto:joe.peterson@dot.ca.gov]
Sent: Monday, July 08, 2013 6:15 PM
To: Foo, Kee Y@DOT; Limas, Tony; Pascal Mascarenhas; Jim St. Martin; Rita Leahy; Russell Snyder
Cc: Vacura, Peter J@DOT; Suszko, Charles D@DOT; Michael Halverson
Subject: Superpave Specification update.

Greetings all:

Attached is the latest version of the Superpave specification. Please review and we can go over comments at the next Superpave subtask group meeting.

Changes include the following:

VMA 1/4" 16.5 at JMF, 15.5 in production
VFA 1/4" 69-79 at JMF, 68-80 in production

VMA 3/8" 15.5 at JMF, 14.5 in production
VFA 3/8" 67-77 at JMF, 66-78 in production.

Add a new row to the mix design acceptance table clarifying testing for VMA on lab produced HMA vs plant produced HMA

Voids in mineral aggregate, Laboratory produced HMA[d] (% min.)					
1/4" grading			--		
3/8" grading	SP-2	16.5	--		
1/2" grading	Asphalt Mixtures Volumetrics[c]	15.5			
3/4" grading		14.5	18.0–23.0		
1" grading		13.5	18.0–23.0		
with NMAS=1"					13.5
with NMAS=3/4"					14.5

[d]The Engineer determines the laboratory prepared HMA value for mix design verification only

July 11, 2013 (Industry)

Looks like a bit of an improvement for VFA requirements, especially for the 3/8" & 1/4" HMA, but I don't think it is enough. As we've discussed in the past, the minimum VFA criteria is meaningless since it is directly related to the minimum required VMA & target voids (4% or 5%). Since the maximum limit for VFA effectively limits how much VMA we can have in the mix, it is more relevant. Asphalt Institute SP-2 has always specified the wider ranges based on traffic levels to allow for various mix types. At design, an ~5% spread is all that is really necessary (if any at all) for a VFA spec range (the minimum is dictated by the minimum VMA, and the max to limit the amount of VMA in the HMA).

For 3/4" HMA the 75% max VFA is probably ok. At 4% Va, this would cap VMA at ~16% (2.5% above the minimum). I doubt many would want to design HMA with much more VMA than that for 3/4".

For 1/2" HMA, I believe the upper VFA limit should be a bit higher. Perhaps 77%? This would cap VMA at 17.4% (2.9% above the minimum).

I believe the upper VFA limit for 3/8" & 1/4" HMA should also be a bit higher. Propose 79% & 80% respectively, capping VMA at ~19% & 20% (~3.5% above the minimum for each).

For 5.0% Va HMA, I believe the 60-70% range should be ok for mix design.

Production is LESS straight-forward. I believe the values given for production are too restrictive. Both VMA & Va are not constant during production, but they tend to trend in the same direction. As we discussed previously, the ranges given will effectively narrow the +/-1.5% allowable production air void range.

If we believe we have an acceptable mix at the specified production minimum VMA and at design air voids +/- 1.5%, then (as at mix design) the VFA is "what it is". For example, in production, for a 3/4" HMA-Type A, results for VMA are 13.0% (14.0% at design) & 2.7% voids. The resulting VFA would be ~79%, nowhere near the max 75 as currently written. This is also clearly seen in the SuperPave data previously distributed by Joe P. I've re-attached Joe's spreadsheet with Va, VMA, & VFA data in the SP-1 tab highlighted. Note that all air voids are within the +/-1.5% & VMA are above the 12.5% minimum. Also note VFA results. Pretty high.

I believe VFA during production should be REPORT ONLY. If Caltrans insists, I don't know what specification values we could propose, and if they would even be meaningful.

Frank Rancadore

Issue 85. Why are we using a 0.8 factor when considering binder replacement for RAP?

(6/18/20123) Resolved.

Issue 86. CT 304 Temperatures

(7-25-2013): Caltrans will highlight the changes in the CT 304 with all the changes noted. send it to Tony L who will send to the industry members.

Greeting:

Attached please find a revised draft copy of CT 304. It addresses problems with temperatures. It is not addressing the pixie dust issue, that is yet to be discussed in the STG. Would you please put out for review and comment, and have all comments to Al Vasquez no later than 1600 7/25/13.

Thank You

Joseph F. Peterson
Office of Roadway Materials
Materials Engineering and Testing Services
California Department of Transportation

California Test 304

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY **July 2013**

DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, California 95819-4612

Issue 1. **METHOD OF TEST FOR PREPARATION OF HMA**
Issue 2. **FOR TEST SPECIMENS**

A. SCOPE

This test method describes the procedure for determining the preparation of laboratory-mixed and field-mixed hot mix asphalt (HMA) specimens. This test method also describes a procedure for the compaction of laboratory-mixed and field-mixed HMA by means of a California Kneading Compactor that imparts a kneading action. This procedure applies to laboratory-mixed and field-mixed HMA containing aggregate up to 1 in. maximum size.

The procedure is presented in two parts:

Part 1. Preparation of laboratory-mixed (lab-mixed) and field-mixed HMA samples.
Part 2. Compaction of lab-mixed and field-mixed HMA using the California Kneading Compactor.

Appendices are included as follows:

Appendix A – Preparation of lab-mixed and field-mixed HMA test specimens containing reclaimed asphalt pavement (RAP).
Appendix B – Preparation of lab-mixed and field-mixed HMA test specimens containing asphalt binder with liquid anti-strip.
Appendix C – Preparation of lab-mixed and field-mixed HMA test specimens containing damp aggregate treated with dry lime.
Appendix D – Preparation of lab-mixed and field-mixed HMA test specimens containing aggregate treated with lime slurry.

More complete descriptions of the procedures needed to prepare lab-mixed HMA samples for mix design and the determination of a job-mix formula (JMF) can be found in the Asphalt Institute MS-2 "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types", Superpave Series No. 2 (SP-2) "Superpave Mix Design", California Test 367, and California Test 368.

PART 1. PREPARATION OF LABORATORY-MIXED AND FIELD-MIXED HMA SAMPLES

Issue 3. **1A. REFERENCES**

California Test 101 – Operation and Calibration of the Mechanical Compactor
California Test 104 – Operation and Calibration of the Electronically Controlled Compactor
California Test 105 – Calculations Pertaining to Gradings and Specific Gravities
California Test 125 – Sampling Highway Materials and Products Used in the Roadway Structural Sections
California Test 202 – Sieve Analysis of Fine and Coarse Aggregates
California Test 206 – Specific Gravity and Absorption of Coarse Aggregate
California Test 207 – Specific Gravity and Absorption of Fine Aggregate
California Test 367 – Optimum Bitumen Content (OBC) for HMA Types A, B, and C, and Rubberized HMA (Type G)
California Test 368 – Optimum Bitumen Content (OBC) for Open Graded Friction Course
AASHTO T 201 – Kinematic Viscosity of Asphalts (Bitumens)
AASHTO T 245 – Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 3549 – Thickness or Height of Compacted Bituminous Paving Mixture Specimens
Issue 4.
Issue 5. **1B. APPARATUS**

1. Ovens:

   a. Oven(s) with free circulation of air for heating aggregates, asphalt binder, mixing bowl, and other equipment to within 5°F of the required lab mixing temperature.

   b. An oven with free circulation of air capable of maintaining a temperature of 140°F ± 5°F or 295°F ± 5°F for curing lab-mixed HMA.

   c. Oven(s) with free circulation of air for heating field-mixed HMA samples to within 5°F of the required temperature (Section 1D.).

2. Balance: a balance or scale accurate to 0.1 g and having a minimum capacity of 5 kg.

3. Sample Splitters:

   a. Riffle-type splitter having individual chutes approximately 50 % larger than the maximum size aggregate in the lab-mixed and field-mixed HMA.

   b. Optional rotating pan type splitter for all lab-mixed and field-mixed HMA.

4. Metal Pans: pans having a surface area of 75 to 100 in.^{2}, and approximately 1 in. deep.

5. Thermometers: thermometers or temperature probes having metal stems with a minimum range of 100 to 400°F, accurate to 5°F or less.

6. Sample Mixing Apparatus: suitable equipment for mixing the aggregate and asphalt binder.

   a. Suitable equipment for hand mixing consists of a sand bath on the surface of a hot plate to minimize localized overheating.

   b. Suitable equipment for mechanical mixing consists of any type of mechanical mixer that can be maintained at the required mixing temperature. Mixing equipment must produce a well-coated, homogeneous mixture of the required amount, and from which essentially all of the batch can be recovered.

Issue 6. **1C. PREPARATION OF LABORATORY-MIXED HMA SPECIMENS**

1. Aggregate

   a. Sample aggregate in accordance with California Test 125.

   b. For mix design (per California Test 367 or others) and other purposes as required, perform a sieve analysis on individual coarse aggregate samples and a washed sieve analysis on individual fine aggregate samples in accordance with California Test 202. Discard fine aggregate samples after the washed sieve analysis.

   c. Determine specific gravity and absorption of the aggregate in accordance with California Test 206 and California Test 207. If there is a difference in specific gravity of 0.2 or more between the coarse and fine parts of different aggregate blends, compute the blend of aggregate required to produce a combined gradation that conforms to specified requirements modified in accordance with California Test 105.

   d. Separate each of the combined aggregate samples on the coarse and fine aggregate sieves in accordance with California Test 202. Use the sieves and pan appropriate for the gradations required for the mix specified.

      NOTE: Use aggregates as received. Do not wash aggregates to be used for preparing lab-mixed HMA for specimens. In the case of coated aggregates, separate by hand if the aggregates are coated to prevent removal of these coatings.

      For a combined aggregate sample, split out no more than 10 kg at a time before separating. For individual bin or stockpile samples, combine no more than 10 kg at a time at the proposed proportions before separating.

   e. Batch the aggregate. The cumulative weight for the required batch is derived by simple computation. An example of this computation for an aggregate batch weight of 1200 g follows.

Sieve Size	Percent Passing	Individual Weight	Cumulative Weight
1 in.	100	0.0	0.0
¾ in.	89	132.0	132.0
½ in.	78	132.0	264.0
⅜ in.	73	60.0	324.0
No. 4	67	72.0	396.0
No. 8	51	192.0	588.0
Pan	0	612.0	1200.0

Passing	Retained	1200 g Batch Weight
1 in.	¾ in.	(100 - 89) X 12 = 132.0
¾ in.	½ in.	(100 - 78) X 12 = 264.0
½ in.	⅜ in.	(100 - 73) X 12 = 324.0
⅜ in.	No. 4	(100 - 67) X 12 = 396.0
No. 4	No. 8	(100 - 51) X 12 = 588.0
No. 8	Pan	(100 - 0) X 12 = 1200.0

2. Asphalt Binder

a. Obtain samples of the asphalt binder that will be used on the project.

b. For hot mix design (per California Test 367), prepare at least 1 sample for each combination of aggregate and binder content. Use at least 4 binder contents in 0.50 % increments for the development of the proposed JMF and the determination of OBC. The Approximate Binder Content (ABC), the ABC - 0.50 %, the ABC + 0.50 %, and the ABC + 1.00 % are the most commonly used 4 binder contents.

Once the OBC has been determined, prepare 3 samples separately at the proposed JMF and test for compliance.

c. Report binder content as a percentage by weight of total mix. An example of computing binder content as a percentage by weight of total mix and asphalt binder batch weights follows:

The total weight of hot mix is expressed as:

$$W_{Mix} = W_{Asph} + W_{Agg} \qquad [1]$$

Where: W_{Mix} = Weight of hot mix asphalt, in grams (g)
W_{Asph} = Weight of asphalt binder, in grams (g)
W_{Agg} = Weight of aggregate, in grams (g)

The percentage of asphalt binder is:

$$P_{Asph} = \left(\frac{W_{Asph}}{W_{Mix}}\right) \times 100 \qquad [2]$$

Where: P_{Asph} = Binder percentage (binder content) by weight of total mix

By rearranging equations [1] and [2], the weight of asphalt binder required for a batch can be determined as follows:

$$W_{Asph} = \frac{W_{Agg} \times P_{Asph}}{1 - P_{Asph}} \qquad [3]$$

Example: Determine the asphalt binder batch weight at a binder content of 5 % (by weight of total mix) with an aggregate batch weight of 1200 g.

Step 1 – Use Equation [3]:

$$W_{Asph} = \frac{1200 \times 0.05}{1 - 0.05} = 63.2$$

Step 2 – Using equation [1], the total weight of hot mix asphalt is:

$$W_{Mix} = W_{Asph} + W_{Agg} = 63.2 + 1200 = 1263.2g$$

Check: To check the binder percentage by weight of total mix, substitute the values obtained in Steps 1 and 2 into equation (2):

$$P_{Asph} = \frac{63.2}{1263.2} \times 100 = 5.0\%$$

3. Mixing and Curing

a. The lab mixing temperatures for the various asphalt binder types are:

Asphalt Binder Type	Lab Mixing Temperature
Neat, unmodified (PG__ - __)	The range of temperature where the unaged asphalt binder has a kinematic viscosity of 170 ± 20 centistokes measured in accordance with AASHTO T 201.
Polymer Modified (PG__ - __PM)	Asphalt supplier's recommended range.
PG__ - __TR	Asphalt supplier's recommended range.
Asphalt Rubber Binder (ARB)	325° to 375°F ±5°F.
Asphalt Binder for OGFC	As specified in California Test 368.

b. Heat the aggregate to the lab mixing temperature.

c. Heat the asphalt binder to the lab mixing temperature, and in no instance exceed 380°F. Do not hold asphalt binder at the lab mixing temperature for more than 2 hours before using. Do not reheat asphalt binder more than 2 times.

d. Place the mixing bowl in the oven or on the sand bath and heat to a temperature not exceeding 50°F above the lab mixing temperature and not exceeding 380°F. Charge the mixing bowl with heated aggregates and dry mix thoroughly. Form a crater in the dry blended aggregate. Remove the asphalt binder from the oven and stir the asphalt binder thoroughly until uniform. Pour the required amount of asphalt binder into the mixture in accordance with the calculated batch weights. At this point the temperature of the aggregate and asphalt binder must be within the limits of the lab mixing temperature (Section 1C.3.a).

NOTE: Before laboratory mixing, prepare 1 mixture at the lowest binder content to butter the mixing bowl. Discard this batch.

e. Mix the aggregate and asphalt binder, preferably with a mechanical mixer, or by hand with a trowel or spoon as quickly and thoroughly as possible, to yield a mixture where all particles are coated. The length of mixing time varies with the type of material, but two to three minutes is generally sufficient.

f. When mixing is completed, transfer the mixture to a metal pan. Cure at a temperature of 140°F ± 5°F in an oven for 15 to 18 hr.

An alternate procedure, when the combined aggregate absorption is less than 2.0 % as determined in accordance with California Test 206 and California Test 207, is to cure the mixture at a temperature of 295°F ± 5°F in an oven for 2 to 3 hr.

NOTE: When transferring the mixture to a suitable pan, the mixing bowl must be scraped in order to transfer the mixture to within ± 0.1 % of the mixture's initial total batch weight.

g. After curing, the mixture is then ready for testing.

Issue 7. **1D. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS**

Field-mixed HMA can be heated for workability a maximum of 2 times, including heating for compaction, to the appropriate temperature as listed below (and as used in Section 2C.3.). Heat the field-mixed HMA for 2 to 3 hr. Do not heat field-mixed HMA more than 3 hr. After heating, the mixture is then ready for testing.

Asphalt Binder Type	Field-Mixed HMA Temperature (Maximum)	OGFC Temperature (Maximum)
Neat, unmodified (PG__ - __)	235°F ± 5°F	235°F ± 5°F
Polymer Modified (PG__ - __PM)	235°F ± 5°F	235°F ± 5°F
PG__ - __TR	235°F ± 5°F	235°F ± 5°F
Asphalt Rubber Binder (ARB)	305°F ± 5°F	305°F ± 5°F

Issue 8.
Issue 9. **1E. REPORTING**

The following information should be included when reporting the test results:

- Mix type (identified as Lab-mixed or Field-mixed HMA)
- Asphalt binder type and content
- Individual and composite aggregate gradation
- Aggregate gradation plot on the FHWA 0.45th power chart
- Additives (if used): Type, percentage and method of incorporation
- Lab-mixed HMA mixing temperature, curing time and temperature, or
- Field-mixed HMA heating time and temperature

PART 2. – COMPACTION OF LAB-MIXED AND FIELD-MIXED HMA USING THE CALIFORNIA KNEADING COMPACTOR

Issue 10.**2A. REFERENCES**

California Test 101 – Operation and Calibration of the Mechanical Compactor
California Test 104 – Operation and Calibration of the Electronically Controlled Compactor
California Test 308 – Method of Test for Determining Bulk Specific Gravity and Density of Compacted Hot Mix Asphalt
California Test 366 – Method of Test for Stabilometer Value
AASHTO T 245 – Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 3549 – Thickness or Height of Compacted Bituminous Paving Mixture Specimens
ANSI B 46.1 – Surface Texture

Issue 11.**2B. APPARATUS**

1. California Kneading Compactor: use a compactor designed to consolidate the material by a series of individual or roving "kneading action" impressions made by a compactor foot. The compactor must be capable of exerting a force of 500 psi under the compactor foot and must be operated and calibrated in accordance with California Test 101 or California Test 104.

2. Compactor Foot: a ram having a face shaped as a sector of a 4 in. diameter circle as shown in California Test 101 and California Test 104 and having an area of approximately 3.2 in^2.

   The temperature of the compactor foot must be maintained at the compaction temperature by means of a variable transformer controlling the foot's heater.

3. Mold Holder: a mold holder placed into position on the California Kneading Compactor and used to center the 4 in. mold and hold it securely in position during compaction.

4. Molds: molds of 4 in. ± 0.005 in. inside diameter and 5 in. ± 0.10 in. height with steel walls that are at least 0.235 in. thick at room temperature (77°F ± 9°F). Molds must be hardened to at least a Rockwell hardness of C48. The initial inside finish of the molds must have a root mean square (rms) of 1.60 µm or smoother in accordance with ANSI B 46.1.

5. Solid Rubber Specimen: a specimen of approximately 4 in. diameter by 2½ in. height designed to fit in the mold for warming-up the California Kneading Compactor.

   NOTE: A handful of rags stuffed into the mold is a suitable alternative.

6. Paper Disks: heavy paper disks of approximately 4 in. diameter designed to fit in the mold.

7. Metal Disks: metal disks of approximately 4 in. diameter designed to fit in the mold.

   NOTE: The base plate used in AASHTO T 245 is a suitable disk.

8. Metal Feeder Trough: a feeder trough 4 in. wide and 16 in. long with a paddle that is shaped to fit the trough.

9. Rod: a round, straight steel rod with a diameter of ⅜ in. ± 1/16 in. and length of at least 16 in. One or both ends of the tamping rod must be rounded to a hemispherical tip of the same diameter as the rod.

10. Mechanical Spader (optional): designed to prevent segregation of coarse and fine material or the formation of rock pockets in the test specimen by introducing the mixture into the compaction mold from an endless belt, at the same time imparting a spading action with four mechanically operated bullet-nosed steel rods that are ½ in. diameter and 23 in. long.

11. Shim: a ¼ in. thick steel shim approximately ¾ in. wide and 2½ in. long.

12. Steel Followers: two steel followers with a flat surface 3.985 in. ± 0.005 in. in diameter; one 5.5 in. ± 0.25 in. in height, the other 1.575 in. ± 0.25 in. in height.

13. Compression Testing Machine: a compression testing machine having a minimum capacity of 50,000 lb and capable of maintaining the specified loading rate (see Section 2C.14.).

14. Specimen Extractor: a steel device in the form of a disk with a diameter not less than 3.95 in. and ½ in. thick for extracting the compacted specimen from the mold.

15. Ovens:

    a. Oven(s) with free circulation of air for heating samples and/or equipment to the required temperature(s).

    b. An oven with free circulation of air capable of maintaining a temperature of 235°F ± 5°F and 305°F ± 5°F for heating lab-mixed and field-mixed HMA samples prior to compaction.

    c. An oven with free circulation of air capable of maintaining a temperature of 140°F ± 5°F for lab-mixed and field-mixed HMA compacted specimens.

16. Balance: a balance or scale having a minimum capacity of 5 kg, accurate to 0.1 g.

Issue 12.

2C. COMPACTION OF LAB-MIXED AND FIELD-MIXED HMA

1. Prepare lab-mixed and/or field-mixed HMA in accordance with California Test 304, Part 1.

NOTE: Normally, 1200 g of dry aggregate is sufficient for the stabilometer specimen. However, if the specific gravity of the aggregate is 2.80 or higher, 1300 g may be required. Three compacted specimens are required for the stabilometer testing per California Test 366, and other test methods may also require multiple compacted specimens.

2. Warm-up the California Kneading Compactor by running it through at least 1 complete cycle (20 tamping blows at 250 psi followed by 150 tamping blows at 500 psi) using the solid rubber specimen or suitable alternative.

3. Use one of the following specified temperatures when compacting the lab-mixed and/or field-mixed HMA:

Asphalt Binder Type	Compaction Temperature
Neat, unmodified (PG__ - __)	235°F ± 5°F
Polymer Modified (PG__ - __PM)	235°F ± 5°F
PG__ - __TR	235°F ± 5°F
Asphalt Rubber Binder (ARB)	305°F ± 5°F

4. Place the appropriate quantity of lab-mixed and/or field-mixed HMA in a metal pan and heat to the compaction temperature in an oven for 2 to 3 hr. Do not heat the HMA mixture for more than 3 hr.

5. Preheat the compactor foot, mold holder (one time only), molds, feeder trough, and rod to the compaction temperature.

6. Place the mold in position in the mold holder and insert a 4 in. diameter paper disk into the mold on top of the mold holder base.

7. Place a steel shim under the edge of the mold adjacent to the portion of the mold holder that extends up into the mold. Tighten the tightening screw on the mold holder.

   NOTE: The maximum time allowed to perform Steps 7 through 9, from removal of the mixture from the oven to starting the compactor, is 1 min. This is necessary to prevent cooling of the sample.

8. Thoroughly mix and disperse the heated mixture in the heated feeder trough. Spread the mixture on the trough to ensure uniformity when transferring to the mold. Use the paddle to push half of the mixture into the mold. Rod this portion of the mixture 20 times in the center of the mass and 20 times around the edge with the heated rod. Push the remainder of the mixture into the mold and repeat the rodding procedure, just penetrating the first lift.

   NOTE: The Mechanical Spader is suitable alternative for placing the mixture into the mold.

9. Place the mold holder containing the mixture and the mold into position in the California Kneading Compactor.

10. Start the compactor and adjust the air pressure to a point where 250 psi will be exerted by the compactor foot.

11. Apply approximately 25 tamping blows at 250 psi to accomplish a semi-compacted condition of the mixture so it will not be unduly disturbed when the 500 psi load is applied. The exact number of blows to accomplish the semi-compaction is determined by observation and may vary between 20 and 50 depending upon the type of HMA.

12. After semi-compaction has been accomplished, remove the shim and release the mold-tightening screw sufficiently to allow approximately ⅛ in. side movement of the mold during the

compaction stroke. Increase the compactor foot pressure to 500 psi and apply 150 tamping blows to complete the compaction.

13. After compaction in the California Kneading Compactor, place the mold and the compacted specimen upright (tamp side up) on a metal disc and place the assembly in an oven at 140°F ± 5°F for the following range of curing time prior to applying the static leveling off load:

Asphalt Binder Type	Curing Time in Oven
Neat, unmodified (PG__ - __)	1½ to 3 hr
Polymer Modified (PG__ - __PM)	1½ to 3 hr
PG__ - __TR	1½ to 3 hr
Asphalt Rubber Binder (ARB)	2 to 3 hr

14. Remove the compacted specimen from the oven and place a 4 in. diameter paper disk on the compacted specimen. Apply a 12,600 lb leveling-off load to the specimen in a compression testing machine. Use a testing machine head or platen speed of 0.25 in./min. Apply the load by the double plunger method in which a free-fitting metal plunger is placed on the top and bottom of the compacted specimen.

    NOTE: If the compression testing machine has a spherically seated type of upper head, use the proper shims to lock it in such a manner that the contact face is fixed firmly in a horizontal plane.

15. Return the compacted specimens for stabilometer tests (and still contained in the mold) to the 140°F ± 5°F oven for 15 min to 2 hr to retain temperature for testing in accordance with California Test 366.

    NOTE: Stabilometer test specimens are also used to obtain the bulk specific gravity in accordance with California Test 308, unless there is a dispute about the bulk specific gravity test result. For dispute resolution, compacted specimens must also be made, without stabilometer testing, to determine the bulk specific gravity.

16. Cool the compacted specimens not used for stabilometer and bulk specific gravity testing to room temperature (77°F ± 9°F) before removing the specimens from the mold by means of a specimen extractor. Measure the height of each compacted specimen at room temperature in accordance with ASTM D 3549 to the nearest 0.01 in. and record the measurement. The compacted specimens are then ready for any other testing.

17. Compacted lab-mixed or field-mixed specimens must be 2.5 in. ± 0.05 in. in height. Compacted specimens for mix design must be 2.5 in. ± 0.10 in. in height.

    NOTE: To determine the required amount of lab-mixed or field-mixed HMA needed to produce a 2.5 in. compacted specimen, it is generally desirable to prepare a trial specimen. For mix designs, the trial specimen should be prepared prior to preparing all the batches. If the trial specimen height falls outside of the height limits, the amount of lab-mixed or field-mixed HMA used for the specimen may be adjusted as follows:

$$Adjusted\ HMA\ Weight = \frac{2.5 \times Weight\ of\ HMA}{Specimen\ height\ obtained}$$

Issue 13.
Issue 14.

2D. REPORTING

The following information should be included when reporting the test results:

- Mix type (identified as lab-mixed or field-mixed HMA)
- Binder type and content
- Compaction temperature
- Curing time and curing temperature (for the stabilometer and bulk specific gravity specimens)

- Compacted specimen height

B. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Caltrans Laboratory Safety Manual is available at:

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

End of Text
(California Test 304 contains 18 pages)

APPENDIX A

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING RECYCLED ASPHALT PAVEMENT (RAP)

A. SCOPE

This appendix includes modifications that must be made to California Test 304 when preparing test specimens of lab-mixed and field-mixed HMA containing RAP.

B. REFERENCED DOCUMENTS

California Test 201 – Soil and Aggregate Sample Preparation
California Test 226 – Determination of Moisture Content by Oven Drying
California Test 309 – Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
California Test 382 – Determination of Asphalt Content of Bituminous Mixtures by the Ignition Method
ASTM D 2172 – Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

C. PREPARATION OF LAB-MIXED HMA SPECIMENS

Issue 15.

Prior to preparing specimens of lab-mixed HMA that contain RAP, the following procedures must be followed:

1. Sample RAP in accordance with California Test 125.

   NOTE: Sample a minimum of 3 separate representative samples of RAP and split each sample into 2 equal parts.

2. Prepare each RAP sample separately for evaluation under California Test 201.

   Split or quarter each RAP sample into representative portions for ASTM D 2172, California Test 309 and California Test 382 testing.

Size of Sample

HMA Aggregate Size	ASTM D 2172 [a]	CT 309 [b]	CT 382 [c]
	Minimum Weight of Sample, g		
2 in.	- -	6000	- -
1½ in.	4000	4000	4000
1 in.	3000	2500	3000
¾ in.	2000	2000	2000
½ in.	1500	1500	1500
⅜ in.	1000	1000	1200
No. 4	500	500	1200

a. ASTM D 2172 is used to determine the asphalt binder content in RAP and RAP gradation for calculating batch weights.
b. California Test 309 is used to calculate the effective specific gravity of the RAP aggregate.
c. California Test 382 is compared with ASTM D 2172 to determine a RAP gradation correlation factor.

3. Determine the binder content of each RAP sample in accordance with ASTM D 2172, Method B (3 minimum). Calculate and report the individual and average binder content. Perform a sieve analysis on each sample of recovered aggregate in accordance with California Test 202, Appendix A (3 minimum). Calculate and report the individual and average gradation.

4. Determine the RAP percentage that will be used in the mix design.

5. Determine the combined gradation of the lab-mixed HMA mixture based on the proposed proportions of RAP and virgin aggregate to be used.

6. Calculate batch weights for each ingredient in the mixture using the information from ASTM D 2172 and the attached "Worksheet for Computing Laboratory Batch Weights for lab-mixed HMA Mixtures Containing RAP" (Figure A1).

NOTE: Other batch worksheets may be used as long as the same information is provided.

7. Oven-dry RAP to a constant weight in accordance with California Test 226, except that the temperature must not exceed 100˚F.

8. Add moisture-free RAP on top of aggregate in the amount needed for a batch and proceed with the lab-mixed HMA specimen preparation (Section 1C.3.).

Issue 16.**D. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS**

There are no modifications.

Worksheet for Computing Laboratory Batch Weights for HMA Mixtures Containing RAP

Date: _____ Mix Type: _____ Prepared By: EXAMPLE for CT 384

% RAP in HMA (15% Max.)	10
Asphalt Content of RAP [1]	5.7
% Hydrated Lime for Coarse Aggregate [2]	0.5
% Hydrated Lime for Fine Aggregate [3]	0.6
% Total Hydrated Lime in Aggregate mixture [3]	1.0

Table 1: Batch Weights for Virgin Aggregate, RAP, New Asphalt Binder, and Hydrated Lime

Parameter \ Sample Number	1	2	3	4	5
Desired Total Asphalt Content of Mix, % by wt. of mix	4.3	4.8	5.3	5.8	6.3
Desired Hot Mix Sample Weight, g	1200	1200	1200	1200	1200
Weight of total Aggregate, g	1148	1142	1136	1130	1124
New Asphalt, % by wt. of mix	4.3	4.8	5.3	5.8	6.3
Weight of New Asphalt to be Added, g	51.6	57.6	63.6	69.6	75.6
RAP, % by wt. of aggregate	0.0	0.0	0.0	0.0	0.0
Weight of RAP to be Added, g	0	0	0	0	0
Weight of Asphalt from RAP, g	0	0	0	0	0
Weight of Virgin Aggregate + Hy. Lime, g	1100	1100	1100	1100	1100
Weight of Virgin Aggregate + Hydrated Lime for Coarse Aggregate, g	1148	1142	1136	1130	1124
Weight of Hydrated Lime for Coarse Aggregate, g	0	0	0	0	0
Weight of Hydrated Lime for Fine Aggregate, g	0	0	0	0	0
Weight of Virgin Aggregate, g	1148	1142	1136	1130	1124
Check	1200	1200	1200	1200	1200

[1] yellow cell denotes a required input.
[2] By weight of total mix. Use average from ASTM D 2172.
[3] This percentage is based on the weight of new virgin aggregate plus hydrated lime
[4] This percentage is based on the weight of total aggregate including RAP aggregates; however, RAP aggregate are not treated with hydrated lime.

Table 2: Combined Gradation Summary

AGGREGATE:	RAP		3/4"		1/2"		3/8"		Rock Dust		Natural Sand		Crushed Sand		Hydrated Lime		Blend *	Specification Limits
% of Blend	10.0		5.0		28.0		28.0		20.0		10.0		0.0		1.0		100.0	
of Blend w/o RAP	0.0		5.8		31.1		28.9		22.2		11.1		0.0		1.1		100.0	
% of Blend w/o RAP or Lime	0.0		5.8		31.5		29.2		22.5		11.2		0.0		0.0		100.0	
Sieve Size	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	Total Blend for RAP a	
1 1/2"	100.0	10.0	100.0	5.0	100.0	28.0	100.0	28.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	100.0	100.0
1"	100.0	10.0	100.0	5.0	100.0	28.0	100.0	28.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	100.0	100.0
3/4"	100.0	10.0	100.0	5.0	100.0	28.0	100.0	28.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	100.0	100
1/2"	100.0	10.0	98.3	4.9	98.3	27.5	100.0	28.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	97.9	90-100
3/8"	100.0	10.0	25.9	1.3	29.9	8.4	96.5	27.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	75.7	65-85
No. 4	83.0	8.3	2.0	0.1	4.3	1.2	47.0	13.2	99.2	19.8	97.5	9.8	0.0	0.0	100.0	1.0	52.4	35-55
No. 8	66.0	6.6	1.0	0.1	3.0	0.8	8.0	2.1	88.7	17.7	80.6	8.1	0.0	0.0	100.0	1.0	36.4	23-40
No. 16	52.0	5.2	1.0	0.1	3.0	0.8	4.0	1.0	66.1	13.2	62.6	6.3	0.0	0.0	100.0	1.0	27.6	20-40
No. 30	39.0	3.9	1.0	0.1	3.0	0.8	3.0	0.8	48.6	9.7	45.3	4.5	0.0	0.0	80.0	0.8	20.4	14-30
No. 50	28.0	2.8	1.0	0.1	2.0	0.6	2.0	0.5	33.0	6.6	27.8	2.7	0.0	0.0	65.0	0.6	13.2	9-21
No. 100	16.0	1.6	1.0	0.1	1.0	0.3	1.0	0.3	21.0	4.2	17.0	1.7	0.0	0.0	50.0	0.5	7.6	4-14
No. 200	10.8	1.1	1.0	0.1	1.0	0.3	1.0	0.3	13.8	2.7	3.2	0.3	0.0	0.0	50.0	0.5	5.2	3-8

* Must = 100%

Table 3: Batch Weights Needed for Each Individual Sieve

Sample	1				2				3				4				5			
Fraction	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula
1 1/2" - 1"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1" - 3/4"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/4" - 1/2"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/2" - 3/8"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/8" - No. 4	13	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No. 4 - No. 8	13	0	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No. 8 - Pan	50	0	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lime	0	1224	1300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asphalt	0	1124	2425	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

This Microsoft Excel Spreadsheet is available at:
http://www.dot.ca.gov/hq/esc/Translab/ofpm/documents/LP_9worksheet.xls
or click here to access the Excel Spreadsheet

FIGURE A1: Example worksheet for Computing Laboratory Batch Weights for HMA Containing RAP

APPENDIX B

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING ASPHALT BINDER TREATED WITH LIQUID ANTISTRIP

A. SCOPE

This appendix includes modifications that must be made to California Test 304 when preparing test specimens of lab-mixed and field-mixed HMA containing asphalt binder treated with liquid anti-strip.

Issue 17.B. PREPARATION OF LAB-MIXED HMA SPECIMENS

1. Heat the asphalt binder to be used in the lab-mixed HMA to the appropriate lab mixing temperature (Section 1C.3.a.).

2. Weigh out a sufficient quantity of asphalt binder into a tared metal container and determine the weight to the nearest 0.1 g.

3. Under a fume hood, slowly stir the required amount of room-temperature (77°F ± 9°F) liquid anti-strip into the required weight of heated asphalt binder.

   NOTE: If the liquid anti-strip is too viscous at room temperature, it may be warmed to the liquid anti-strip producer's recommended temperature and thoroughly stirred prior to adding it to the asphalt binder.

4. Use a stirring rod to blend the liquid anti-strip and asphalt binder together for a minimum of 2 min.

5. Maintain the treated asphalt binder at the lab mixing temperature specified until it is used.

   NOTE: Discard the treated asphalt binder if it is not used the same day it is prepared, or if it is allowed to cool so that it requires reheating.

6. Proceed with the lab-mixed HMA specimen preparation (Section 1C.3.).

Issue 18.C. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS

There are no modifications.

APPENDIX C

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING DAMP AGGREGATE TREATED WITH DRY LIME

A. SCOPE

This appendix includes modifications that must be made to California Test 304 when preparing lab-mixed and field-mixed HMA test specimens containing damp aggregate treated with dry hydrated lime.

B. REFERENCED DOCUMENTS

California Test 226 – Determination of Moisture Content by Oven Drying

C. PREPARATION OF LAB-MIXED HMA SPECIMENS

1. Aggregate Treated with Lime Without Marination

   a. Before adding lime, place the combined dry aggregate batch in a mixing bowl and add 2 % water by dry weight of aggregate.

      Mix the aggregate with water for 1 to 2 min, then add the required proportion of hydrated lime and continue mixing for 2 to 3 additional minutes.

      NOTE: Add more moisture, if necessary, to assure complete coating of aggregate particles in lime.

   b. After mixing, oven-dry the lime-treated aggregate to a constant weight in accordance with California Test 226, except that the temperature must be the specified lab mixing temperature (Section 1C.3.a.).

      NOTE: If fine particles or lime residue stick to the pan after drying, use a short-bristle brush to remove the material and recombine it with the rest of the lime-treated aggregate.

   c. Proceed with the lab-mixed HMA specimen preparation.

2. Aggregate Treated with Lime and Marinated

   a. Batch coarse and fine aggregate fractions separately.

   b. Oven-dry the coarse and fine aggregate fractions in accordance with California Test 226, and then cool to room temperature (77°F ± 9°F).

   c. Add 1 % water by dry weight of coarse aggregate to the coarse fraction, and add 2 % water by dry weight of fine aggregate to the fine fraction.

   d. Mix each coarse and fine fraction with the water for 1 to 2 min, then add the required proportion of hydrated lime to each coarse and fine fraction, and then continue mixing each fraction for 2 to 3 additional minutes.

      NOTE: Add more moisture to the coarse and fine fraction, if necessary, to achieve complete coating of aggregate particles in lime.

   e. Marinate the coarse and fine fractions separately in air-tight plastic containers for 24 to 96 hr.

   f. In a mixing bowl, combine the marinated aggregate fractions and mix the composite blend thoroughly with a trowel or spoon. Break up any clumps.

g. Transfer the lime-treated marinated aggregate to a pan and oven-dry to a constant weight under California Test 226, except that the temperature must be the specified lab mixing temperature (Section 1C.3.a.).

NOTE: If fine particles or lime residue stick to the pan after drying, use a short-bristle brush to remove the material and recombine it with the rest of the lime-treated marinated aggregate.

h. Proceed with lab-mixed HMA specimen preparation (Section 1C.3.).

D. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS

There are no modifications.

APPENDIX D

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING AGGREGATE TREATED WITH LIME SLURRY

A. SCOPE

This appendix contains modifications that must be made to California Test 304 when preparing lab-mixed and field-mixed HMA test specimens containing aggregate treated with hydrated lime slurry.

B. PREPARATION OF LAB-MIXED HMA SPECIMENS

1. Batch coarse and fine aggregate fractions separately.

2. Oven dry the coarse and fine aggregate fractions in accordance with California Test 226 and allow them to cool to room temperature (77°F ± 9°F).

3. Add 1 % water by dry weight of aggregate to the respective coarse and fine aggregate fractions and place the fractions in separate air-tight plastic containers to retain moisture while preparing the lime slurry.

4. Determine the weight of lime required (by dry weight of aggregate) to provide the required lime content of each coarse and fine aggregate fraction. Mix 1 part lime to 2 parts water. Break up any clumps in the lime slurry.

5. Separately, add the required amount of lime slurry to each coarse and fine aggregate fraction. In separate mixing bowls, use a trowel or spoon to thoroughly mix the slurry with each moisture-conditioned coarse and fine aggregate fraction. Stir each fraction for a minimum of 3 min.

6. Marinate the coarse and fine fractions separately in air-tight plastic containers for 24 to 96 hr.

7. In a mixing bowl, combine the marinated aggregate fractions and mix the composite blend thoroughly with a trowel or spoon. Break up any clumps.

8. Transfer the lime-treated, marinated aggregate to a pan and oven dry to a constant weight in accordance with California Test 226, except that the temperature must be the specified lab mixing temperature (Section 1C.3.a.).

   NOTE: If fine particles or lime residue stick to the pan after drying, use a short-bristle brush to remove the material and recombine it with the rest of the lime-treated marinated aggregate.

9. Proceed with the lab-mixed HMA specimen preparation (Section 1C.3.).

C. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS

There are no modifications.

Industry Comments (July 12, 2013)

DEPARTMENT OF TRANSPORTATION
DIVISION OF ENGINEERING SERVICES
Transportation Laboratory
5900 Folsom Blvd.
Sacramento, California 95819-4612

Issue 19. **METHOD OF TEST FOR PREPARATION OF HMA**
Issue 20. **FOR TEST SPECIMENS**

C. SCOPE

This test method describes the procedure for determining the preparation of laboratory-mixed and field-mixed hot mix asphalt (HMA) specimens. This test method also describes a procedure for the compaction of laboratory-mixed and field-mixed HMA by means of a California Kneading Compactor that imparts a kneading action. This procedure applies to laboratory-mixed and field-mixed HMA containing aggregate up to 1 in. maximum size.

The procedure is presented in two parts:

Part 1. Preparation of laboratory-mixed (lab-mixed) and field-mixed HMA samples.
Part 2. Compaction of lab-mixed and field-mixed HMA using the California Kneading Compactor.

Appendices are included as follows:

Appendix A – Preparation of lab-mixed and field-mixed HMA test specimens containing reclaimed asphalt pavement (RAP).
Appendix B – Preparation of lab-mixed and field-mixed HMA test specimens containing asphalt binder with liquid anti-strip.
Appendix C – Preparation of lab-mixed and field-mixed HMA test specimens containing damp aggregate treated with dry lime.
Appendix D – Preparation of lab-mixed and field-mixed HMA test specimens containing aggregate treated with lime slurry.

More complete descriptions of the procedures needed to prepare lab-mixed HMA samples for mix design and the determination of a job-mix formula (JMF) can be found in the Asphalt Institute MS-2 "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types", Superpave Series No. 2 (SP-2) "Superpave Mix Design", California Test 367, and California Test 368.

PART 1. PREPARATION OF LABORATORY-MIXED AND FIELD-MIXED HMA SAMPLES

Issue 21.1A. REFERENCES

California Test 101 – Operation and Calibration of the Mechanical Compactor
California Test 104 – Operation and Calibration of the Electronically Controlled Compactor
California Test 105 – Calculations Pertaining to Gradings and Specific Gravities
California Test 125 – Sampling Highway Materials and Products Used in the Roadway Structural Sections
California Test 202 – Sieve Analysis of Fine and Coarse Aggregates
California Test 206 – Specific Gravity and Absorption of Coarse Aggregate
California Test 207 – Specific Gravity and Absorption of Fine Aggregate
California Test 367 – Optimum Bitumen Content (OBC) for HMA Types A, B, and C, and Rubberized HMA (Type G)
California Test 368 – Optimum Bitumen Content (OBC) for Open Graded Friction Course
AASHTO T 201 – Kinematic Viscosity of Asphalts (Bitumens)
AASHTO T 245 – Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

ASTM D 3549 – Thickness or Height of Compacted Bituminous Paving Mixture Specimens
Issue 22.
Issue 23.**1B. APPARATUS**

1. Ovens:

   a. Oven(s) with free circulation of air for heating aggregates, asphalt binder, mixing bowl, and other equipment to within 5°F of the required lab mixing temperature.

   b. An oven with free circulation of air capable of maintaining a temperature of 140°F ± 5°F or 295°F ± 5°F for curing lab-mixed HMA.

   c. Oven(s) with free circulation of air for heating field-mixed HMA samples to within 5°F of the required temperature (Section 1D.).

2. Balance: a balance or scale accurate to 0.1 g and having a minimum capacity of 5 kg.

3. Sample Splitters:

   a. Riffle-type splitter having individual chutes approximately 50 % larger than the maximum size aggregate in the lab-mixed and field-mixed HMA.

   b. Optional rotating pan type splitter for all lab-mixed and field-mixed HMA.

4. Metal Pans: pans having a surface area of 75 to 100 in.^{2}, and approximately 1 in. deep.

5. Thermometers: thermometers or temperature probes having metal stems with a minimum range of 100 to 400°F, accurate to 5°F or less.

6. Sample Mixing Apparatus: suitable equipment for mixing the aggregate and asphalt binder.

   c. Suitable equipment for hand mixing consists of a sand bath on the surface of a hot plate to minimize localized overheating.

   d. Suitable equipment for mechanical mixing consists of any type of mechanical mixer that can be maintained at the required mixing temperature. Mixing equipment must produce a well-coated, homogeneous mixture of the required amount, and from which essentially all of the batch can be recovered.

Issue 24.**1C. PREPARATION OF LABORATORY-MIXED HMA SPECIMENS**

4. Aggregate

   a. Sample aggregate in accordance with California Test 125.

   b. For mix design (per California Test 367 or others) and other purposes as required, perform a sieve analysis on individual coarse aggregate samples and a washed sieve analysis on individual fine aggregate samples in accordance with California Test 202. Discard fine aggregate samples after the washed sieve analysis.

   c. Determine specific gravity and absorption of the aggregate in accordance with California Test 206 and California Test 207. If there is a difference in specific gravity of 0.2 or more between the coarse and fine parts of different aggregate blends, compute the blend of aggregate required to produce a combined gradation that conforms to specified requirements modified in accordance with California Test 105.

   d. Separate each of the combined aggregate samples on the coarse and fine aggregate sieves in accordance with California Test 202. Use the sieves and pan appropriate for the gradations required for the mix specified.

NOTE: Use aggregates as received. Do not wash aggregates to be used for preparing lab-mixed HMA for specimens. In the case of coated aggregates, separate by hand if the aggregates are coated to prevent removal of these coatings.

For a combined aggregate sample, split out no more than 10 kg at a time before separating. For individual bin or stockpile samples, combine no more than 10 kg at a time at the proposed proportions before separating.
We need further discussion of this. Do we need to add the #30 mesh sieve for separating a fraction between #30 and Pan? There is a spec requirement on this and it would add a little more control on the mix design testing.

e. Batch the aggregate. The cumulative weight for the required batch is derived by simple computation. An example of this computation for an aggregate batch weight of 1200 g follows.

Sieve Size	Percent Passing	Individual Weight	Cumulative Weight
1 in.	100	0.0	0.0
¾ in.	89	132.0	132.0
½ in.	78	132.0	264.0
⅜ in.	73	60.0	324.0
No. 4	67	72.0	396.0
No. 8	51	192.0	588.0
Pan	0	612.0	1200.0

Passing	Retained	1200 g Batch Weight
1 in.	¾ in.	(100 - 89) X 12 = 132.0
¾ in.	½ in.	(100 - 78) X 12 = 264.0
½ in.	⅜ in.	(100 - 73) X 12 = 324.0
⅜ in.	No. 4	(100 - 67) X 12 = 396.0
No. 4	No. 8	(100 - 51) X 12 = 588.0
No. 8	Pan	(100 - 0) X 12 = 1200.0

5. Asphalt Binder

d. Obtain samples of the asphalt binder that will be used on the project.

e. For hot mix design (per California Test 367), prepare at least 1 sample (Do we need to prepare Gmm samples also. This becomes more critical as we get into Superpave and use Gmm for compaction control and volumetrics.) for each combination of aggregate and binder content. Use at least 4 binder contents in 0.50 % increments (Do we need to change this increment to reflect tighter specification controls for AC%) for the development of the proposed JMF and the determination of OBC. The Approximate Binder Content (ABC), the ABC - 0.50 %, the ABC + 0.50 %, and the ABC + 1.00 % are the most commonly used 4 binder contents.

Once the OBC has been determined, prepare 3 samples separately at the proposed JMF and test for compliance.

f. Report binder content as a percentage by weight of total mix. An example of computing binder content as a percentage by weight of total mix and asphalt binder batch weights follows:

The total weight of hot mix is expressed as:

$$W_{Mix} = W_{Asph} + W_{Agg} \qquad [1]$$

Where: W_{Mix} = Weight of hot mix asphalt, in grams (g)
W_{Asph} = Weight of asphalt binder, in grams (g)

W_{Agg} = Weight of aggregate, in grams (g)

The percentage of asphalt binder is:

$$P_{Asph} = \left(\frac{W_{Asph}}{W_{Mix}}\right) \times 100 \qquad [2]$$

Where: P_{Asph} = Binder percentage (binder content) by weight of total mix

By rearranging equations [1] and [2], the weight of asphalt binder required for a batch can be determined as follows:

$$W_{Asph} = \frac{W_{Agg} \times P_{Asph}}{1 - P_{Asph}} \qquad [3]$$

Example: Determine the asphalt binder batch weight at a binder content of 5 % (by weight of total mix) with an aggregate batch weight of 1200 g.

Step 1 – Use Equation [3]:

$$W_{Asph} = \frac{1200 \times 0.05}{1 - 0.05} = 63.2$$

Step 2 – Using equation [1], the total weight of hot mix asphalt is:

$$W_{Mix} = W_{Asph} + W_{Agg} = 63.2 + 1200 = 1263.2\text{g}$$

Check: To check the binder percentage by weight of total mix, substitute the values obtained in Steps 1 and 2 into equation (2):

$$P_{Asph} = \frac{63.2}{1263.2} \times 100 = 5.0\%$$

6. Mixing and Curing

h. The lab mixing temperatures for the various asphalt binder types are:

Asphalt Binder Type	Lab Mixing Temperature
Neat, unmodified (PG__ - __)	The range of temperature where the unaged asphalt binder has a kinematic viscosity of 170 ± 20 centistokes (Should we be using units that are more common now – Pa.s)measured in accordance with AASHTO T 201.
Polymer Modified (PG__ - __PM)	Asphalt supplier's recommended range.
PG__ - __TR	Asphalt supplier's recommended range.
Asphalt Rubber Binder (ARB)	325° to 375°F ±5°F.
Asphalt Binder for OGFC	As specified in California Test 368.

i. HHeat the aggregate to the lab mixing temperature.

j. Heat the asphalt binder to the lab mixing temperature, and in no instance exceed 380°F (Even if the supplier recommends it?). Do not hold asphalt binder at the lab mixing

temperature for more than 2 hours before using. Do not reheat asphalt binder more than 2 times.

k. Place the mixing bowl in the oven or on the sand bath and heat to a temperature not exceeding 50°F above the lab mixing temperature and not exceeding 380°F. Charge the mixing bowl with heated aggregates and dry mix thoroughly. Form a crater in the dry blended aggregate. Remove the asphalt binder from the oven and stir the asphalt binder thoroughly until uniform. Pour the required amount of asphalt binder into the mixture in accordance with the calculated batch weights. At this point the temperature of the aggregate and asphalt binder must be within the limits of the lab mixing temperature (Section 1C.3.a).

NOTE: Before laboratory mixing, prepare 1 mixture at the lowest binder content to butter the mixing bowl. Discard this batch.

l. Mix the aggregate and asphalt binder, preferably with a mechanical mixer, or by hand with a trowel or spoon as quickly and thoroughly as possible, to yield a mixture where all particles are coated. The length of mixing time varies with the type of material, but two to three minutes is generally sufficient.

m. When mixing is completed, transfer the mixture to a metal pan. Cure at a temperature of 140°F ± 5°F in an oven for 15 to 18 hr.

An alternate procedure, when the combined aggregate absorption is less than 2.0 % as determined in accordance with California Test 206 and California Test 207, is to cure the mixture at a temperature of 295°F ± 5°F in an oven for 2 to 3 hr. (Would the procedure used need to be reported in the mix design?)

NOTE: When transferring the mixture to a suitable pan, the mixing bowl must be scraped in order to transfer the mixture to within ± 0.1 % of the mixture's initial total batch weight.

n. After curing, the mixture is then ready for testing.

Issue 25.**1D. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS**

Field-mixed HMA can be heated for workability a maximum of 2 times, including heating for compaction, to the appropriate temperature as listed below (and as used in Section 2C.3.). Heat the field-mixed HMA for 2 to 3 hr. Do not heat field-mixed HMA more than 3 hr. After heating, the mixture is then ready for testing.

Asphalt Binder Type	**Field-Mixed HMA Temperature (Maximum)**	**OGFC Temperature (Maximum)**
Neat, unmodified (PG__ - __)	235°F ± 5°F	235°F ± 5°F
Polymer Modified (PG__ - __PM)	235°F ± 5°F	235°F ± 5°F
PG__ - __TR	235°F ± 5°F	235°F ± 5°F
Asphalt Rubber Binder (ARB)	305°F ± 5°F	305°F ± 5°F

Issue 26.

Issue 27.**1E. REPORTING**

The following information should be included when reporting the test results:

- Mix type (identified as Lab-mixed or Field-mixed HMA)
- Asphalt binder type and content
- Individual and composite aggregate gradation
- Aggregate gradation plot on the FHWA 0.45th power chart
- Additives (if used): Type, percentage and method of incorporation
- Lab-mixed HMA mixing temperature, curing time and temperature, or
- Field-mixed HMA heating time and temperature
- Procedure used in curing?

PART 2. – COMPACTION OF LAB-MIXED AND FIELD-MIXED HMA USING THE CALIFORNIA KNEADING COMPACTOR

Issue 28.**2A. REFERENCES**

California Test 101 – Operation and Calibration of the Mechanical Compactor
California Test 104 – Operation and Calibration of the Electronically Controlled Compactor
California Test 308 – Method of Test for Determining Bulk Specific Gravity and Density of Compacted Hot Mix Asphalt
California Test 366 – Method of Test for Stabilometer Value
AASHTO T 245 – Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 3549 – Thickness or Height of Compacted Bituminous Paving Mixture Specimens
ANSI B 46.1 – Surface Texture

Issue 29.**2B. APPARATUS**

15. California Kneading Compactor: use a compactor designed to consolidate the material by a series of individual or roving "kneading action" impressions made by a compactor foot. The compactor must be capable of exerting a force of 500 psi under the compactor foot and must be operated and calibrated in accordance with California Test 101 or California Test 104.

16. Compactor Foot: a ram having a face shaped as a sector of a 4 in. diameter circle as shown in California Test 101 and California Test 104 and having an area of approximately 3.2 in^2.

    The temperature of the compactor foot must be maintained at the compaction temperature by means of a variable transformer controlling the foot's heater. (Do we use an infrared gun to determine this?)

17. Mold Holder: a mold holder placed into position on the California Kneading Compactor and used to center the 4 in. mold and hold it securely in position during compaction.

18. Molds: molds of 4 in. ± 0.005 in. inside diameter and 5 in. ± 0.10 in. height with steel walls that are at least 0.235 in. thick at room temperature (77°F ± 9°F). Molds must be hardened to at least a Rockwell hardness of C48. The initial inside finish of the molds must have a root mean square (rms) of 1.60 µm or smoother in accordance with ANSI B 46.1.

19. Solid Rubber Specimen: a specimen of approximately 4 in. diameter by 2½ in. height designed to fit in the mold for warming-up the California Kneading Compactor.

    NOTE: A handful of rags stuffed into the mold is a suitable alternative.

20. Paper Disks: heavy paper disks of approximately 4 in. diameter designed to fit in the mold.

21. Metal Disks: metal disks of approximately 4 in. diameter designed to fit in the mold.

NOTE: The base plate used in AASHTO T 245 is a suitable disk.

22. Metal Feeder Trough: a feeder trough 4 in. wide and 16 in. long with a paddle that is shaped to fit the trough.

23. Rod: a round, straight steel rod with a diameter of ⅜ in. ± 1/16 in. and length of at least 16 in. One or both ends of the tamping rod must be rounded to a hemispherical tip of the same diameter as the rod.

24. Mechanical Spader (optional): designed to prevent segregation of coarse and fine material or the formation of rock pockets in the test specimen by introducing the mixture into the compaction mold from an endless belt, at the same time imparting a spading action with four mechanically operated bullet-nosed steel rods that are ½ in. diameter and 23 in. long.

25. Shim: a ¼ in. thick steel shim approximately ¾ in. wide and 2½ in. long.

26. Steel Followers: two steel followers with a flat surface 3.985 in. ± 0.005 in. in diameter; one 5.5 in. ± 0.25 in. in height, the other 1.575 in. ± 0.25 in. in height.

27. Compression Testing Machine: a compression testing machine having a minimum capacity of 50,000 lb and capable of maintaining the specified loading rate (see Section 2C.14.).

28. Specimen Extractor: a steel device in the form of a disk with a diameter not less than 3.95 in. and ½ in. thick for extracting the compacted specimen from the mold.

15. Ovens:

    a. Oven(s) with free circulation of air for heating samples and/or equipment to the required temperature(s).

    b. An oven with free circulation of air capable of maintaining a temperature of 235°F ± 5°F and 305°F ± 5°F for heating lab-mixed and field-mixed HMA samples prior to compaction.

    c. An oven with free circulation of air capable of maintaining a temperature of 140°F ± 5°F for lab-mixed and field-mixed HMA compacted specimens.

16. Balance: a balance or scale having a minimum capacity of 5 kg, accurate to 0.1 g.

Issue 30.**2C. COMPACTION OF LAB-MIXED AND FIELD-MIXED HMA**

18. Prepare lab-mixed and/or field-mixed HMA in accordance with California Test 304, Part 1.

    NOTE: Normally, 1200 g of dry aggregate is sufficient for the stabilometer specimen. However, if the specific gravity of the aggregate is 2.80 or higher, 1300 g may be required. Three compacted specimens are required for the stabilometer testing per California Test 366, and other test methods may also require multiple compacted specimens. (So, do we prepare just one sample as mentioned above or HAVE to do three samples?)

19. Warm-up the California Kneading Compactor by running it through at least 1 complete cycle (20 tamping blows at 250 psi followed by 150 tamping blows at 500 psi) using the solid rubber specimen or suitable alternative.

20. Use one of the following specified temperatures when compacting the lab-mixed and/or field-mixed HMA:

Asphalt Binder Type	Compaction Temperature
Neat, unmodified (PG__ - __)	235°F ± 5°F
Polymer Modified (PG__ - __PM)	235°F ± 5°F
PG__ - __TR	235°F ± 5°F
Asphalt Rubber Binder (ARB)	305°F ± 5°F

21. Place the appropriate quantity of lab-mixed and/or field-mixed HMA in a metal pan and heat to the compaction temperature in an oven for 2 to 3 hr. Do not heat the HMA mixture for more than 3 hr.

22. Preheat the compactor foot to compaction temperature?, mold holder (one time only (the first one in a series?)), molds, feeder trough, and rod to the compaction temperature.

23. Place the mold in position in the mold holder and insert a 4 in. diameter paper disk into the mold on top of the mold holder base.

24. Place a steel shim under the edge of the mold adjacent to the portion of the mold holder that extends up into the mold (Opposite to the screw). Tighten the tightening screw on the mold holder.

    NOTE: The maximum time allowed to perform Steps 7 through 9, from removal of the mixture from the oven to starting the compactor, is 1 min. This is necessary to prevent cooling of the sample.

25. Thoroughly mix and disperse the heated mixture in the heated feeder trough. Spread the mixture on the trough to ensure uniformity when transferring to the mold. (put a 4 in diameter paper disc into the mold) Use the paddle to push half of the mixture into the mold. Rod this portion of the mixture 20 times in the center of the mass and 20 times around the edge with the heated rod. Push the remainder of the mixture into the mold and repeat the rodding procedure, just penetrating the first lift.

    NOTE: The Mechanical Spader is suitable alternative for placing the mixture into the mold.

26. Place the mold holder containing the mixture and the mold into position in the California Kneading Compactor.

27. Start the compactor and adjust the air pressure to a point where 250 psi will be exerted by the compactor foot.

28. Apply approximately 25 tamping blows at 250 psi to accomplish a semi-compacted condition of the mixture so it will not be unduly disturbed when the 500 psi load is applied. The exact number of blows to accomplish the semi-compaction is determined by observation and may vary between 20 and 50 depending upon the type of HMA.

29. After semi-compaction has been accomplished, remove the shim and release the mold-tightening screw sufficiently to allow approximately ⅛ in. side movement of the mold during the compaction stroke. Increase the compactor foot pressure to 500 psi and apply 150 tamping blows to complete the compaction.

30. After compaction in the California Kneading Compactor, (remove the 4 in diameter paper disc) place the mold and the compacted specimen upright (tamp side up) on a metal disc and place the assembly in an oven at 140°F ± 5°F for the following range of curing time prior to applying the static leveling off load:

Asphalt Binder Type	Curing Time in Oven
Neat, unmodified (PG__ - __)	1½ to 3 hr
Polymer Modified (PG__ - __PM)	1½ to 3 hr
PG__ - __TR	1½ to 3 hr
Asphalt Rubber Binder (ARB)	2 to 3 hr

31. Remove the compacted specimen from the oven and place a 4 in. diameter paper disk on the compacted specimen (Is a paper disc necessary at this point?). Apply a 12,600 lb leveling-off load to the specimen in a compression testing machine. Use a testing machine head or platen speed of 0.25 in./min. Apply the load by the double plunger method in which a free-fitting metal plunger is placed on the top and bottom of the compacted specimen.

    NOTE: If the compression testing machine has a spherically seated type of upper head, use the proper shims to lock it in such a manner that the contact face is fixed firmly in a horizontal plane.

32. Return the compacted specimens (after leveling-off load) for stabilometer tests (and still contained in the mold) to the 140°F ± 5°F oven for 15 min to 2 hr to retain temperature for testing in accordance with California Test 366.

    NOTE: Stabilometer test specimens are also used to obtain the bulk specific gravity in accordance with California Test 308, unless there is a dispute about the bulk specific gravity test result. For dispute resolution, compacted specimens must also be made, without stabilometer testing, to determine the bulk specific gravity.

33. Cool the compacted specimens not used for stabilometer and bulk specific gravity testing to room temperature (77°F ± 9°F) before removing the specimens from the mold by means of a specimen extractor. Measure the height of each compacted specimen at room temperature in accordance with ASTM D 3549 to the nearest 0.01 in. and record the measurement. The compacted specimens are then ready for any other testing.

34. Compacted lab-mixed or field-mixed specimens must be 2.5 in. ± 0.05 in. in height. Compacted specimens for mix design must be 2.5 in. ± 0.10 in. in height. (Do we no longer use the stability height correction charts?)

    NOTE: To determine the required amount of lab-mixed or field-mixed HMA needed to produce a 2.5 in. compacted specimen, it is generally desirable to prepare a trial specimen. For mix designs, the trial specimen should be prepared prior to preparing all the batches. If the trial specimen height falls outside of the height limits, the amount of lab-mixed or field-mixed HMA used for the specimen may be adjusted as follows:

$$Adjusted\ HMA\ Weight = \frac{2.5 \times Weight\ of\ HMA}{Specimen\ height\ obtained}$$

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Issue 32.**2D. REPORTING**

The following information should be included when reporting the test results:

- Mix type (identified as lab-mixed or field-mixed HMA)
- Binder type and content
- Compaction temperature
- Curing time and curing temperature (for the stabilometer and bulk specific gravity specimens)
- Compacted specimen height

D. HEALTH AND SAFETY

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Caltrans Laboratory Safety Manual is available at:

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

End of Text
(California Test 304 contains 18 pages)

APPENDIX A

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING RECYCLED ASPHALT PAVEMENT (RAP)

D. SCOPE

This appendix includes modifications that must be made to California Test 304 when preparing test specimens of lab-mixed and field-mixed HMA containing RAP.

E. REFERENCED DOCUMENTS

California Test 201 – Soil and Aggregate Sample Preparation
California Test 226 – Determination of Moisture Content by Oven Drying
California Test 309 – Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
California Test 382 – Determination of Asphalt Content of Bituminous Mixtures by the Ignition Method
ASTM D 2172 – Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

F. PREPARATION OF LAB-MIXED HMA SPECIMENS

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Prior to preparing specimens of lab-mixed HMA that contain RAP, the following procedures must be followed:

1. Sample RAP in accordance with California Test 125.

   NOTE: Sample a minimum of 3 separate representative samples of RAP and split each sample into 2 equal parts.

2. Prepare each RAP sample separately for evaluation under California Test 201.

   Split or quarter each RAP sample into representative portions for ASTM D 2172 (which method?) , California Test 309 and California Test 382 testing.

Size of Sample

HMA Aggregate Size	ASTM D 2172 [a]	CT 309 [b]	CT 382 [c]
	Minimum Weight of Sample, g		
2 in.	- -	6000	- -
1½ in.	4000	4000	4000
1 in.	3000	2500	3000
¾ in.	2000	2000	2000
½ in.	1500	1500	1500
⅜ in.	1000	1000	1200
No. 4	500	500	1200

a. ASTM D 2172 (Identify the method #) is used to determine the asphalt binder content in RAP and RAP gradation for calculating batch weights.
b. California Test 309 is used to calculate the effective specific gravity of the RAP aggregate.
c. California Test 382 is compared with ASTM D 2172 to determine a RAP gradation correlation factor.

3. Determine the binder content of each RAP sample in accordance with ASTM D 2172, Method B (3 minimum). Calculate and report the individual and average binder content. Perform a sieve analysis on each sample of recovered aggregate in accordance with California Test 202, Appendix A (3 minimum). Calculate and report the individual and average gradation.

4. Determine the RAP percentage that will be used in the mix design.

5. Determine the combined gradation of the lab-mixed HMA mixture based on the proposed proportions of RAP and virgin aggregate to be used.

6. Calculate batch weights for each ingredient in the mixture using the information from ASTM D 2172 and the attached "Worksheet for Computing Laboratory Batch Weights for lab-mixed HMA Mixtures Containing RAP" (Figure A1).

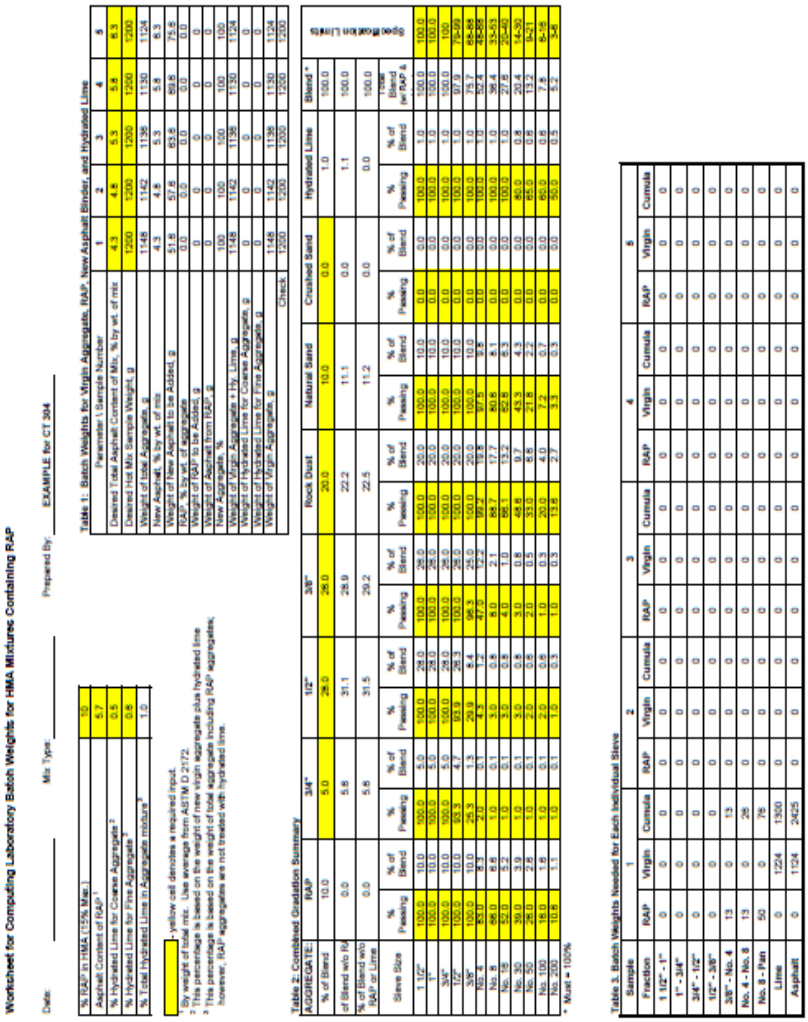
NOTE: Other batch worksheets may be used as long as the same information is provided.

7. Oven-dry RAP to a constant weight in accordance with California Test 226, except that the temperature must not exceed 100˚F. (Allow for higher temperatures for defined periods so that the combined mix does not drop in temperature. This becomes more critical with higher RAP %)

8. Add moisture-free RAP on top of aggregate in the amount needed for a batch and proceed with the lab-mixed HMA specimen preparation (Section 1C.3.).

Issue 34.**D. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS**

There are no modifications.



Worksheet for Computing Laboratory Batch Weights for HMA Mixtures Containing RAP

Date: _____ Mix Type: _____ Prepared By: EXAMPLE for CT 304

% RAP in HMA (15% Max.)	15
Asphalt Content of RAP [1]	5.7
% Hydrated Lime for Coarse Aggregate [2]	0.5
% Hydrated Lime for Fine Aggregate [2]	0.6
% Total Hydrated Lime in Aggregate mixture [3]	1.0

- yellow cell denotes a required input.
[1] By weight of total mix. Use average from ASTM D 2172.
[2] This percentage is based on the weight of new virgin aggregate plus hydrated lime
[3] This percentage is based on the weight of total aggregate including RAP aggregates; however, RAP aggregates are not treated with hydrated lime.

Table 1 - Batch Weights for Virgin Aggregate, RAP, New Asphalt Binder, and Hydrated Lime

Parameter \ Sample Number	1	2	3	4	5
Desired Total Asphalt Content of Mix, % by wt. of mix	4.3	4.8	5.3	5.8	6.3
Desired Hot Mix Sample Weight, g	1200	1200	1200	1200	1200
Weight of total Aggregate, g	1148	1142	1136	1130	1124
New Asphalt, % by wt. of mix	4.3	4.8	5.3	5.8	6.3
Weight of New Asphalt to be Added, g	51.6	57.6	63.6	69.6	75.6
RAP, % by wt. of aggregate	0.0	0.0	0.0	0.0	0.0
Weight of RAP to be Added, g	0	0	0	0	0
Weight of Asphalt from RAP, g	0	0	0	0	0
New Aggregate, %	100	100	100	100	100
Weight of Virgin Aggregate + Hy. Lime, g	1148	1142	1136	1130	1124
Weight of Hydrated Lime for Coarse Aggregate, g	0	0	0	0	0
Weight of Hydrated Lime for Fine Aggregate, g	0	0	0	0	0
Weight of Virgin Aggregate, g	1148	1142	1136	1130	1124
Check	1200	1200	1200	1200	1200

Table 2: Combined Gradation Summary

AGGREGATE:	RAP		3/4"		1/2"		3/8"		Rock Dust		Natural Sand		Crushed Sand		Hydrated Lime		Blend *		Specification Limits
% of Blend	10.0		5.0		25.0		25.0		20.0		10.0		0.0		1.0		100.0		
of Blend w/o RAP or Lime	0.0		5.8		31.1		28.9		22.2		11.1		0.0		1.1		100.0		
% of Blend w/o RAP or Lime	0.0		5.8		31.5		29.2		22.5		11.2		0.0		0.0		100.0	Total Blend w/ RAP & Lime	
Sieve Size	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing	% of Blend	% Passing		
1 1/2"	100.0	10.0	100.0	5.0	100.0	25.0	100.0	25.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	100.0	100.0	
1"	100.0	10.0	100.0	5.0	100.0	25.0	100.0	25.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	100.0	100.0	
3/4"	100.0	10.0	100.0	5.0	100.0	25.0	100.0	25.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	100.0	100.0	
1/2"	100.0	10.0	95.3	4.9	98.9	24.7	100.0	25.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	99.9	99.9	
3/8"	100.0	10.0	75.3	1.5	29.9	8.4	96.5	24.0	100.0	20.0	100.0	10.0	0.0	0.0	100.0	1.0	75.7	75.7	65-85
No. 4	83.0	8.3	21.0	0.1	4.3	1.2	47.0	13.2	99.2	19.8	97.5	9.8	0.0	0.0	100.0	1.0	52.4	52.4	35-65
No. 8	66.0	6.6	1.0	0.1	3.0	0.8	4.0	2.1	85.7	17.7	80.6	8.1	0.0	0.0	100.0	1.0	38.4	38.4	33-53
No. 16	52.0	5.2	1.0	0.1	3.0	0.8	4.0	1.0	66.1	13.2	62.6	6.3	0.0	0.0	100.0	1.0	27.6	27.6	20-40
No. 30	39.0	3.9	1.0	0.1	3.0	0.8	3.0	0.8	48.6	9.7	45.3	4.5	0.0	0.0	80.0	0.8	20.4	20.4	14-30
No. 50	28.0	2.8	1.0	0.1	2.0	0.5	2.0	0.5	33.0	6.6	31.8	2.2	0.0	0.0	65.0	0.6	13.2	13.2	8-21
No. 100	19.0	1.9	1.0	0.1	1.0	0.3	1.0	0.3	21.0	4.2	21.0	1.1	0.0	0.0	50.0	0.5	7.8	7.8	4-12
No. 200	10.8	1.1	1.0	0.1	1.0	0.3	1.0	0.3	13.8	2.7	13.2	0.7	0.0	0.0	35.0	0.3	5.2	5.2	3-6

* Must = 100%

Table 3. Batch Weights Needed for Each Individual Sieve

Sample	1			2			3			4			5		
Fraction	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula	RAP	Virgin	Cumula
1 1/2" - 1"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1" - 3/4"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/4" - 1/2"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1/2" - 3/8"	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3/8" - No. 4	13	0	13	0	0	0	0	0	0	0	0	0	0	0	0
No. 4 - No. 8	13	0	26	0	0	0	0	0	0	0	0	0	0	0	0
No. 8 - Pan	50	0	76	0	0	0	0	0	0	0	0	0	0	0	0
Lime	0	1224	1300	0	0	0	0	0	0	0	0	0	0	0	0
Asphalt	0	1124	2425	0	0	0	0	0	0	0	0	0	0	0	0

This Microsoft Excel Spreadsheet is available at:
http://www.dot.ca.gov/hq/esc/Translab/ofpm/documents/LP_9worksheet.xls
or click here to access the Excel Spreadsheet

FIGURE A1: Example worksheet for Computing Laboratory Batch Weights for HMA Containing RAP

APPENDIX B

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING ASPHALT BINDER TREATED WITH LIQUID ANTISTRIP

B. SCOPE

This appendix includes modifications that must be made to California Test 304 when preparing test specimens of lab-mixed and field-mixed HMA containing asphalt binder treated with liquid anti-strip.

Issue 35.

B. PREPARATION OF LAB-MIXED HMA SPECIMENS

7. Heat the asphalt binder to be used in the lab-mixed HMA to the appropriate lab mixing temperature (Section 1C.3.a.).

8. Weigh out a sufficient quantity of asphalt binder into a tared metal container and determine the weight to the nearest 0.1 g.

9. Under a fume hood, slowly stir the required amount of room-temperature (77°F ± 9°F) liquid anti-strip into the required weight of heated asphalt binder.

   NOTE: If the liquid anti-strip is too viscous at room temperature, it may be warmed to the liquid anti-strip producer's recommended temperature and thoroughly stirred prior to adding it to the asphalt binder.

10. Use a stirring rod to blend the liquid anti-strip and asphalt binder together for a minimum of 2 min.

11. Maintain the treated asphalt binder at the lab mixing temperature specified until it is used.

    NOTE: Discard the treated asphalt binder if it is not used the same day it is prepared, or if it is allowed to cool so that it requires reheating.

12. Proceed with the lab-mixed HMA specimen preparation (Section 1C.3.).

Issue 36.

C. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS

There are no modifications.

APPENDIX C

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING DAMP AGGREGATE TREATED WITH DRY LIME

E. SCOPE

This appendix includes modifications that must be made to California Test 304 when preparing lab-mixed and field-mixed HMA test specimens containing damp aggregate treated with dry hydrated lime.

F. REFERENCED DOCUMENTS

California Test 226 – Determination of Moisture Content by Oven Drying

G. PREPARATION OF LAB-MIXED HMA SPECIMENS

3. Aggregate Treated with Lime Without Marination

   d. Before adding lime, place the combined dry aggregate batch in a mixing bowl and add 2 % water by dry weight of aggregate.

      Mix the aggregate with water for 1 to 2 min, then add the required proportion of hydrated lime and continue mixing for 2 to 3 additional minutes.

      NOTE: Add more moisture, if necessary, to assure complete coating of aggregate particles in lime.

   e. After mixing, oven-dry the lime-treated aggregate to a constant weight in accordance with California Test 226, except that the temperature must be the specified lab mixing temperature (Section 1C.3.a.).

      NOTE: If fine particles or lime residue stick to the pan after drying, use a short-bristle brush to remove the material and recombine it with the rest of the lime-treated aggregate.

   f. Proceed with the lab-mixed HMA specimen preparation.

4. Aggregate Treated with Lime and Marinated

   i. Batch coarse and fine aggregate fractions separately.

   j. Oven-dry the coarse and fine aggregate fractions in accordance with California Test 226, and then cool to room temperature (77°F ± 9°F).

   k. Add 1 % water by dry weight of coarse aggregate to the coarse fraction, and add 2 % water by dry weight of fine aggregate to the fine fraction.

   l. Mix (Separately) each coarse and fine fraction with the water for 1 to 2 min, then add the required proportion of hydrated lime to each coarse and fine fraction, and then continue mixing each fraction for 2 to 3 additional minutes.

      NOTE: Add more moisture to the coarse and fine fraction, if necessary, to achieve complete coating of aggregate particles in lime.

   m. Marinate the coarse and fine fractions separately in air-tight plastic containers for 24 to 96 hr.

   n. In a mixing bowl, combine the marinated aggregate fractions and mix the composite blend thoroughly with a trowel or spoon. Break up any clumps.

o. Transfer the lime-treated marinated aggregate to a pan and oven-dry to a constant weight under California Test 226, except that the temperature must be the specified lab mixing temperature (Section 1C.3.a.).

NOTE: If fine particles or lime residue stick to the pan after drying, use a short-bristle brush to remove the material and recombine it with the rest of the lime-treated marinated aggregate.

p. Proceed with lab-mixed HMA specimen preparation (Section 1C.3.).

H. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS

There are no modifications.

APPENDIX D

METHOD OF PREPARATION OF LAB-MIXED AND FIELD-MIXED HMA TEST SPECIMENS CONTAINING AGGREGATE TREATED WITH LIME SLURRY

D. SCOPE

This appendix contains modifications that must be made to California Test 304 when preparing lab-mixed and field-mixed HMA test specimens containing aggregate treated with hydrated lime slurry.

E. PREPARATION OF LAB-MIXED HMA SPECIMENS

10. Batch coarse and fine aggregate fractions separately.

11. Oven dry the coarse and fine aggregate fractions in accordance with California Test 226 and allow them to cool to room temperature (77°F ± 9°F).

12. Add 1 % water by dry weight of aggregate to the respective coarse and fine aggregate fractions and place the fractions in separate air-tight plastic containers to retain moisture while preparing the lime slurry.

13. Determine the weight of lime required (by dry weight of aggregate) to provide the required lime content of each coarse and fine aggregate fraction. Mix 1 part lime to 2 parts water. Break up any clumps in the lime slurry.

14. Separately, add the required amount of lime slurry to each coarse and fine aggregate fraction. In separate mixing bowls, use a trowel or spoon to thoroughly mix the slurry with each moisture-conditioned coarse and fine aggregate fraction. Stir each fraction for a minimum of 3 min.

15. Marinate the coarse and fine fractions separately in air-tight plastic containers for 24 to 96 hr.

16. In a mixing bowl, combine the marinated aggregate fractions and mix the composite blend thoroughly with a trowel or spoon. Break up any clumps.

17. Transfer the lime-treated, marinated aggregate to a pan and oven dry to a constant weight in accordance with California Test 226, except that the temperature must be the specified lab mixing temperature (Section 1C.3.a.).

    NOTE: If fine particles or lime residue stick to the pan after drying, use a short-bristle brush to remove the material and recombine it with the rest of the lime-treated marinated aggregate.

18. Proceed with the lab-mixed HMA specimen preparation (Section 1C.3.).

F. PREPARATION OF FIELD-MIXED HMA (LOOSE MIX) SPECIMENS

There are no modifications.

Issue 87: Aggregate degradation during AC plant production

Fines generated by aggregate degradation during AC plant production can significantly affect the volumetric of production HMA. Production HMA (with post production aggregate gradation) may have problem verifying against submitted Job Mix Formula (JMF) which is based on pre-production aggregate gradation.

(7-25-2013): Caltrans would consider an upper limit for pixie dust of 1%. **Industry will discuss the proposed scoping document for CT 304 and get back to this group by the next meeting.**