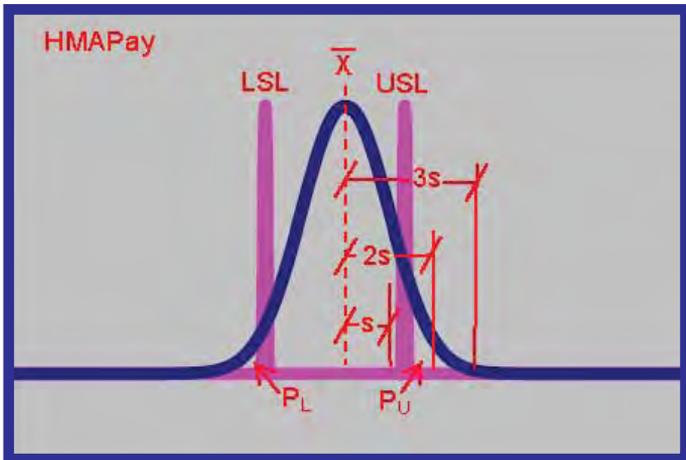


Hot Mix Asphalt Pay User Guide

HMAPay, Version 1.10

(for Microsoft Excel 2007 and later)



State of California Department of Transportation
Division of Construction
March 2011



Hot Mix Asphalt Pay User Guide (Version 1.10)

Use this guide to set up and maintain the Hot Mix Asphalt Pay (HMAPay) program. Use of HMAPay is required on projects that specify HMA production and placement under Section 39-4, “Quality Control Quality Assurance Construction Process,” of the *Standard Specifications*.

HMAPay is a Microsoft Excel spreadsheet program containing several layers of worksheets that:

- Allow both the engineer and contractor to record and share their test data electronically.
- Analyze test data against the HMA Quality Control Quality Assurance (QCQA) specification requirements.
- Highlight test data when it requires corrective action and stopping production.
- Compare contractor and engineer test data for verification purposes.
- Calculate incentive or disincentive cost adjustment due for a specified lot.
- Graph the contractor and engineer’s test data.
- Graph statistical distribution of the QCQA data. The graphs visually demonstrate the verification process as well as the statistical amount of material within and outside specification limits.

See Appendix I, for steps to enable macros in Excel 2007.

See Appendix II for frequently asked questions (FAQs).

See Appendix III for changes to Versions 1.06, 1.07, 1.08, and 1.09

LotInfo Worksheet and Initial Setup

1. After setting up a “trusted folder” (see Appendix I), download the latest version of HMAPay (v1.10). xlsx, an Excel 2007 file formatted for worksheets with macros. Save it with a new *.xlsx name.
2. Fill out the self-explanatory “LotInfo” worksheet before paving begins, preferably at the prepaving meeting. Fill in fields highlighted with a gray background.



3. The QCQA coordinator or resident engineer can fill out the worksheet together with the contractor. Ensure that both parties have the same project information on their versions of the spreadsheet.

Required cell input:

- a. Project name.
- b. EA or Project Identification Number (PID).
- c. Job Mix Formula (JMF) number.
- d. Co/Rte/PM.
- e. HMA type from the drop-down menu, for example, $\frac{3}{4}$ " HMA Type A.
- f. Binder type, for example, PG 64-10, asphalt rubber, PG 64-28PM.
- g. Contractor.
- h. Quality control manager.
- i. Resident engineer.
- j. Item price:
Enter the item price, which, when combined with the composite pay factor, will calculate the appropriate cost adjustment for HMA.
- k. Bid item number.
- l. Target values for gradations:
Enter the value according to the verified JMF (CEM-3513, "Caltrans Hot Mix Asphalt Verification").
- m. Target value for binder content:
Enter the value according to the verified JMF (CEM-3513).
- n. Target value for air voids:
Enter the value according to the project special provisions.

Note: the target value must be 4.0 percent for HMA Type A, either 4.0 percent or 5.0 percent for Type C, and either 3.0 percent, 4.0 percent or 5.0 percent for RHMA, depending on what the special provisions specify. For RHMA, the specification writer must select specific air void target based on region and traffic index.

Hot Mix Asphalt Pay User Guide

4. Click on or to indicate whether VMA, VFA, and DP are specification requirements or report only. Select “Yes” if CEM-3511 shows that the target value for bitumen content is greater than ± 0.3 percent of the optimum bitumen content (OBC) shown on CEM-3512. Select “No” if CEM-3511 shows that the target value for bitumen content is less than or is equal to ± 0.3 percent of the OBC shown on CEM-3512.
5. Click on this button.

The button will lock the LotInfo worksheet to prevent inadvertent changes, especially to the JMF target values.
6. Save the file.
7. The contractor and resident engineer should each get a copy of HMAPay. Both parties should review the project information entered in the LotInfo worksheet for completeness and accuracy before using the HMAPay program.

Quality Control Data Worksheet

The contractor’s quality control manager follows these procedures on the Quality Control Data (QCData) Worksheet using the HMAPay program.

1. Enters the applicable quality control test data on the QCData worksheet. HMAPay version 1.10 will accommodate up to 100 sublots. This worksheet has one row for each subplot of data. Columns B, D, and G to Column AJ are self-explanatory. Columns G to Column U are mandatory for each subplot. Missing data in Columns G to Column U is considered out of specification and may activate the “STOP PRODUCTION” flag ().
2. Enters quality control test results one row (one subplot) at a time. Each row of quality control test results is checked against its own rule as it is entered.
 - a. Rule 1. The first quality control test to fall out of specification will be highlighted yellow (). The second consecutive quality control test to fall out of specification will be highlighted red. Red is a stop production flag.



- b. Rule 2. Checking begins on the fifth subplot because at least five quality control test results are needed for statistical calculation. The rule calculates individual and composite quality factors from the quality control test results.

If the individual quality factor falls out of specification (for example, $QF_{QC1} < 0.75$; $QF_{QC2} < 0.75$; $QF_{QC3} < 0.9$; $QF_{QC4} < 0.9$; $QC_{QF5} < 0.9$), the quality control test result will be highlighted red and trigger the stop production flag. If the lot's composite quality factor falls out of specification (for example, $QF_c < 0.9$), quality control test results for that subplot will be highlighted red, triggering the stop production flag.

Reminder: The specifications require the contractor to enter the quality control percentage of MTD values, even though the resident engineer's quality assurance percentages of MTD values are used for acceptance and payment purposes.

- c. Rule 3. Requires that quality control test data be report-only. Since no specification limits exist, no stop production flag can be triggered.
 - d. Rule 4. Requires no reporting.
4. Save the quality control data (QCData, columns A to AJ) into an Excel file for exporting to the resident engineer (filename defaults to EA/PID_QCData.xls) by clicking this macro execution button.

Contractor's Button
click here to export
quality control data

*Tip: A common practice is to modify the name so it includes the generated date. For example, 01-234564-10-12-10.xls. Because this data sheet doesn't contain macros, it can remain in *.xls.*

5. Email the file (EA/PID_QCData.xls) to the resident engineer using the contractor's regular email system. The resident engineer can review the quality control data in EA/PID_QCData.xls by importing data from the file, using this macro execution button.

Engineer's Button
Click here to import
quality control data.

The importing function opens a temporary worksheet, “Imported QCData,” with new or changed quality control data highlighted purple, for the resident engineer to review. The resident engineer accepts or rejects the data using the corresponding buttons.

The contractor’s quality control manager has defined timelines to report the required quality control test results. It is important that the contractor enters all the required quality control data into the HMAPay program in a timely manner so the statistical analysis is performed and the quality factors can be monitored. The contractor must export the data file and send it to the resident engineer as soon as possible for analysis. See the table in Section 39-4.02C in the *Standard Specifications* for maximum reporting time allowance.

Quality Assurance Data Worksheet

Resident engineers follow these procedures on the quality assurance data (QAData) worksheet using their copy of the HMAPay program:

1. After receiving the quality control data test file, the resident engineer imports the data into the QCData worksheet of the HMAPay program.
2. The resident engineer manually enters quality assurance test results into the respective row (subplot) as soon as the test results are available. Each quality assurance test result is checked against the applicable rule.
 - a. For Rule 1, the first quality assurance test to fall out of specification will be highlighted yellow. Because the resident engineer tests at a frequency of at least one in five, cells with no data are assumed to be in specification. The second consecutive quality assurance test to fall out of specification will be highlighted red, an action that will trigger the stop production flag. If a test is highlighted yellow, the engineer should run the samples from the adjacent sublots.
 - b. For Rule 2, the QF_{QC5} is calculated using the engineer’s %MTD test values and shown adjacent to the %MTD test values. If the QF_{QC5} falls out of spec ($QF_{QC5} < 0.90$), the %MTD value will be highlighted red and trigger the stop production flag.

For Rule 2X, a QF_{QC} cannot be calculated because of insufficient data. The engineer’s test values under Rule 2X are highlighted “pink” if a test value falls outside the specification limits. Test data highlighted

“pink” should not be construed as a stop production flag. Under Rule 2X, if a test falls out of specification, the engineer should immediately notify the contractor. It is important to recognize that if the engineer’s tests do not verify the contractor’s tests, the engineer’s tests may be used to determine the quality factor for the lot. For this reason it is important that the engineer recognize the need to communicate test results quickly to the contractor.

- c. The resident engineer can save the quality assurance data (Columns A to AJ) into an Excel file for exporting to the contractor (filename defaulted to EA/PID_QAData.xls) by clicking this macro execution button.

ENGINEER'S BUTTON
Click here to export
quality assurance data.

3. The resident engineer emails the file (EA/PID_QAData.xls) to the contractor, who can review the QA data in EA_QCData.xls by importing the file using this macro execution button.

CONTRACTOR'S BUTTON
click here to import
quality control data

The resident engineer must enter the required quality assurance data and import the contractor’s quality control data into the HMAPay program in a timely manner so the verification analysis is performed and the quality can be monitored.

LotXPay Worksheet

The resident engineer uses this worksheet to verify the quality control test results using quality assurance test results in a predefined lot and to calculate a pay adjustment for that lot. After identifying the appropriate “Begin Lot” and “End Lot” in the QCData worksheet, Column C, the resident engineer follows the procedure below. Note: A begin lot must be set after each end lot for correct lot and subplot numbering

Hot Mix Asphalt Pay User Guide

1. Makes three inputs into the gray cells on this worksheet:
 - a. Enters the Lot No to be considered into cell H3.
 - b. Using the button to the right of cell H3, runs the macro in the cell to bring the specific lot data over to the worksheet.
 - c. In Total Lot Tonnage HMATT, (cell G115) enters the total HMA tonnage the lot represents.
 - d. In Waived Tons (cell U131), enters total HMA tonnage in the lot that has compaction waived.

The worksheet performs a verification check for quality control test results used to calculate QF_{QC_i} for $i = 1$ to 4.

2. If either of the cells on row 101 yields a “No,” the resident engineer does not verify the lot and **immediately** notifies the contractor in writing that the lot has failed verification. Click on the button below to preview a sample letter that you can cut and paste.

Click here to preview a sample letter notifying the contractor that verification of this lot has failed.

Note: Sample letter is in “VeriLetter” worksheet.

Note: Make sure verification failure is not because the engineer has provided insufficient quality assurance test data (INS.DATA).

Note: Section 39-4.04B, “Verification, Sampling, and Testing,” of the Standard Specifications reads that if the reason for the (non-verification) difference cannot be found and corrected, Caltrans’ test results are used for acceptance.

Independent of the outcome of the verification check, the worksheet calculates pay adjustment for the lot: QF_{QC_i} for $i = 1$ to 4 using the quality control test results and QF_{QC_i} for $i = 5$ using the quality assurance test results.

Note: The bell curves on row 117 provide a visual of the statistical variability of the test data used in the incentive calculation. The area under the curve that falls outside the specification limits corresponds to the percentage of material statistically out of specification.



Control Charts Worksheets

The quality control chart graphs the contractor's data. The quality assurance charts worksheet graphs the resident engineer's data. The combined worksheet graphs both the quality control data and quality assurance data. It is recommended that both parties perform frequent reviews of the combined chart to help address testing issues before they create a non-verification.

The x-axis on each worksheet shows all 100 tests that can be recorded on the QCData and QAData worksheets. Data points on these charts are not broken down by subplot. The "0" value on the y-axis represents the target values. The red horizontal lines above and below the "0" value correspond with the upper and lower specification limits. It is important to recognize that, even if all data is within the specification limits, the quality control and quality assurance specifications calculate a statistical curve using the average and standard deviation of the test data and compare that curve against the specification limits to determine the theoretical total amount of material statistically out of specification.

Appendix I

Enabling Macros in Microsoft Office 2007

Excel 2007 includes additional security features, one of which requires that Excel files with macros be named as *.xlsm files to ensure that users know that it contains macros. You must enable macros in Excel 2007 to use HMAPay v1.10. You must take steps to allow the macros in a .xlsm to run.

Although users can simply “enable all macros” with Excel 2007, *we do not recommend it* because doing so will open up Excel to run any file with macros and defeat many of the additional security measures in Excel 2007.

We do recommend defining a “trusted location” (folder) and placing the .xlsm file in it. The *.xlsm file can run unencumbered if you open it from within a trusted folder.

Users can define as many trusted folders as necessary and designate if “subfolders” within the those folders should be designated as “trusted.” To set up a trusted folder, follow these steps:

1. If you have the “Developer tab already shown at the top of your screen skip ahead to Step 2, otherwise follow these steps to add it:
 - a. Click on the “Office Button” (the round MSOffice logo in the top left corner of the screen).
 - b. A new window will open. At the bottom of this window, click on “Excel Options.”
 - c. A new small window will appear. At its left edge, ensure that you have selected “Popular,” check the box next to “Show Developer Tab in Ribbon,” and click “OK.”
2. Select Developer>Macro Security>Trusted Locations>Add New Locations, and browse to the folder or folders you want to set as trusted locations. When you select each folder, you have the option of allowing trusted “subfolders” within the selected one.
3. Now that you have your trusted location folder set up, download, copy, or save the latest “HMAPayV1.10.xlsm” file to it.
4. Follow the steps in the HMAPay user guide to set up a file for your specific job, give it a name, and run the file from the trusted location.

Appendix II

Frequently Asked Questions

Changes from Version 1.09 to Version 1.10 (December 2010)

1. Why upgrade to Version 1.10?

Version 1.10 made several changes. See the discussion of changes in Appendix III.

2. How do I tell which version of HMAPay program am I using?

Go to the LotInfo worksheet. If cell A3 says, “HMAPay Version 1.10 (for Excel 2007 or later),” you have Version 1.10. If it’s blank, you have Version 1.08 or earlier.

3. Can one party use Version 1.10 and the other party use Version 1.08?

No. Both parties must use the same version. Exported data in the previous versions are laid out differently. The exported file in Version 1.10 has six additional columns (that is, columns A through F, located to the left of the two-inch sieve). If you import data from a Version 1.08 into a Version 1.10, for example, the data will be offset by six columns.

4. What if we have an ongoing job and the contractor and resident engineer both have been using HMAPay Version 1.08? Now one party has their Microsoft Excel upgraded to Microsoft Excel 2007, and they have to switch to Version 1.10.

Caltrans has upgraded districts to Excel 2007. Both parties need to use 2007 or later, since the macros in HMAPay Version 1.10 use its enhanced functionality. Using earlier versions will cause errors.

5. Okay, so we both have to switch, but we already have data in our old Version 1.08 spreadsheets. How do we place it into the new spreadsheet (Version 1.10)?

Insert six additional blank columns at the left edge of the V1.08 data file.

If you need step-by-step guidance, follow these steps. If you encounter difficulties contact waheed.marroof@dot.ca.gov for assistance.

- a. *Download Version 1.10 HMAPay Program from the Caltrans website.*



- b. *Follow the normal steps:*
 - (1) *Select the mix type.*
 - (2) *Enter the target values.*
 - (3) *Select either “Yes” or “No” macro buttons.*
 - (4) *Click the orange macro button to lock the spreadsheet.*
 - (5) *Save the file, noting the name and location. If you have Excel 2007, save it as *.xlsm. Close the V1.10 HMAPay file.*
- c. *Transfer the data from Version 1.08 to Version 1.10 using these steps:*
 - (1) *Open the V1.08 file. Export the quality control data file from the Version 1.08 spreadsheet. Save to a location and name it “V1.08 xx-xxxxxx4 QCData.”*
 - (2) *Export the quality assurance data file from the Version 1.08 spreadsheet. Save to a location and name it “V1.08 xx-xxxxxx4 QADData.” Close the V1.08 file.*
- d. *Modify the temporary exported files to the layout required by Version 1.10, adding six columns.*
 - (1) *Open the “V1.08 xx-xxxxxx4 QCData” file; insert six columns left of column A. Save it as “new V1.10 xx-xxxxxx4 QCData.”*
 - (2) *Open the “V1.08 xx-xxxxxx4 QADData” file; insert six columns left of column A. Save it as “new V1.10 xx-xxxxxx4 QADData.”*
- e. *Close all open spreadsheets and open the new Version 1.10 HMAPay spreadsheets saved in step 5b (5) above.*
- f. *Go to the QCData worksheet. Import the “new V1.10 xx-xxxxxx4 QCData” file, and accept the data.*
- g. *Go to the QADData worksheet. Import the “new V1.10 xx-xxxxxx4 QADData” file, and accept the data.*
- h. *Manually enter in the old dates.*
- i. *Send the file to the other party.*
- j. *Continue the project ensuring that you are importing a Version 1.10 file from within a Version 1.10 file.*

6. How do I deal with the 100 percent compaction requirement waived for a specified lot?

HMAPay Version 1.10 assumes that the resident engineer has at least the five density measurements in each project required to calculate quality factor for density. Use this calculated quality factor for density and HMA quantity (minus any waived HMA quantity) to determine pay adjustment for density.

In your case, 100 percent of the HMA quantity is waived from compaction. This means the state will not be taking any cores for density measurements. Without at least five resident engineer density measurements, HMAPay cannot calculate the quality factor for density. Cell U129 of the LotxPay worksheet (quality factor for density) will either show "DIV/0" or "#REF," and total adjustment to lot (Cell U136) cannot be calculated.

Your solution is to input on the QCData and QADData worksheets five "dummy" density measurements (93.0, 93.5, 94.0, 94.5, and 95.0) for the first five sublots of each lot on the QCData and QADData worksheets. HMAPay can now calculate a quality factor for density.

*Now it is important that you waive 100 percent of the HMA quantity in cell U131. Set the value in U131 equal to Cell G115Pay adjustment for density is then calculated as $\text{Total HMA} - \text{Waived HMA} * f$ (quality factor for density) which will result in zero adjustment (that is, $PF = 1.0$) for density, because $\text{Total HMA} - \text{Waived HMA}$ is zero. The five dummy density measurements do not affect anything; rather, they let the program calculate a quality factor for density to continue the program.*

Appendix III

Changes from Version 1.06

- Fixed formula to calculate “Xc” in the Verification Report in LotxPay worksheet. Used rows 21 to 47 (Version 1.07) instead of rows 23 to 49 (Version 1.06).
- Fixed formula to “2nd check, is $|Xc - Xv| < \text{All.Diff.}$ ” in the Verification Report in LotxPay worksheet. Check for 0.1 percent difference (Version 1.07) instead of 1.0 percent difference (Version 1.06) for binder content.

Changes from Version 1.07 to Version 1.08

- Increased column width to correctly display numbers in LotxPay worksheet.
- Stop import data from QCData worksheet and QAData worksheet if lot size is greater than 27 and flag warning.
- Debug first verification check (is $t \leq t_{\text{crit}}$) and second verification check ($|Xc - Xv| \leq \text{All. Diff}$) and finally verified (Yes/No).
- Correct Xc for Compaction and Density.
- Change “printing” non-verified mix letter to preview a sample of non-verified mix letter. Users can modify, copy, cut, and paste the sample letter to suit their needs.

Changes from Version 1.08 to Version 1.09

Note: Version 1.09 was issued on a limited basis to a few projects throughout the state. Projects using V1.09 must transfer their QC and QA data to HMAPay V1.10 (or most current version).

- Upgraded program to be compatible with Microsoft Excel 2007.
- Added text to cell A3 on the LotInfo worksheet to identify which version of HMAPay is in use. Cell A3 will state, “*HMAPay Version 1.09 (for Excel 2007 and earlier)*” and link to this user guide.
- Revised importing and exporting macro to transfer test dates along with test data. Data imported into a Version 1.09 HMAPay program must be from a Version 1.09 program. If you export data from a Version 1.08 export file to a Version 1.09, all test data will shift over six columns.

Hot Mix Asphalt Pay User Guide

- Added text to the import macros to remind users of this requirement.
- Added functionality to handle six Type C mix designs.
- Added functionality to allow future versions of HMA Pay to add up to 12 new mix designs.
- Added the Rule 2 quality factor checks of the quality assurance data.

Note: Revised to Rule 2X in Version 1.10.

- Added two worksheets with charts. The new quality assurance charts worksheet shows quality assurance data. The new combined charts” worksheet combines the quality control and quality assurance data on one chart.
- Corrected the text in cells A27 on the QCData and QADData worksheets from “Sublot No.” to “Test Number.”
- Corrected language in message boxes which appear while running the import quality assurance import macro to state that the quality assurance file was imported.
- Revised the messaging on the LotxPay sheet to prevent users from importing more than 27 sublots. Previously, you could not remove the yellow message box without unlocking spreadsheet.
- Added data validation to columns G through U to require quality control and quality assurance test values to be entered according to applicable California Test Method (CTM) requirements. Added validation checks to make sure that entries are in numeric values, not text, and that values are not entered with more significant digits than the CTM requires.
- Added comment to the LotInfo worksheet cell R26 to require entering air voids as either a 3.0 percent, 4.0 percent, or 5.0 percent, depending on the mix type. (See note 3n on page 2 in the LotInfo worksheet instructions.)
- Added text to control charts to indicate target values and upper and lower specification limits.
- Added statistical bell (normal distribution) curves to the QCQA incentive calculations on the LotxPay worksheet (rows 116 to 118). The curves are plotted for the specified lot with the average and standard deviation values

used to develop the quality factors (QFs) shown immediately below each curve. The worksheet also shows upper and lower specification limits to provide a visual of how the contractor's quality control has been implemented. The area under the curve between the specification limits corresponds to the statistical amount of material within specification. Likewise, the area under the curve, but outside of the specification limits, corresponds to the statistical amount of material outside the specifications (the "Pu+Pl" value shown on row 127).

- Added macros to the QCData and QAData worksheets that restore conditional formatting if a user enters data by cutting and pasting without using the "paste special-values only" function. The conditional formatting highlights violations of specification rules described under Rule 1, Rule 2, and Rule 2X.
- Repaired a Rule 2 check. Before this repair, Rule 2 violations would only trigger a stop production or reject message based on analysis of six or more tests when the specifications require five or more.
- Modified the check of voids in mineral aggregate (VMA) as it pertains to the two RHMA mix types covered in HMAPay. This modification checks for both upper and lower specification limits when an RMHA mix type is selected. Before the change, the program checked only the lower specification limit.

Change from Version 1.09 to Version 1.10

Revised all QAData Rule 2 checks (except %MTD) to Rule 2X. Rule 2X simply highlights QA data with a weighting factor "pink" if a test result falls outside of the specification. (Rule 2X does not apply to the QC data or to QA's %MTD data)