

WISCONSIN DEPARTMENT OF TRANSPORTATION

Bureau of Technical Services

WisDOT HMA PWL Guide

WISDOT BUREAU OF TECHNICAL SERVICES

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The purpose of this document is to provide guidance to contractors and department staff, both consultant and DOT, performing work under the HMA Pavement Percent Within Limits QMP Standardized Special Provision (HMA PWL STSP). Construction staff representing the DOT on projects, whether consultant or department, are hereinafter referred to as department representative (dept. rep.). This comprehensive guide outlines suggested best practices while also addressing frequently asked questions presented to the Department from both contractors and dept. reps. This document is not to be a substitute for reading and understanding the HMA PWL STSPs. Also, there is required HMA PWL training available on the LearnCenter. While some highlighted best practices are not specification items, they have been added to ensure there is an understanding of how to achieve the highest level of performance. It should be noted the HMA PWL STSPs replaces certain portions of the Standard Specification. The two documents must be carefully read together to apply the intent of the specification correctly.

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Pre-Production

1. GENERAL PROJECT PLANNING

- 1.1 Design guidance is available in FDM 19-21. This document is available here: <http://wisconsindot.gov/rdwy/fdm/fd-19-21.pdf>
- 1.2 All HMA PWL STSP's and Appendix A are available on the WisDOT STSP Page found here: <https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/stsp.aspx>
- 1.3 HMA PWL excel files are available on the Pantry Spreadsheets website found here: <https://awpkb.dot.wi.gov/Content/constr/Pantry/StatewideXLS.htm> Download a new spreadsheet from the Pantry Spreadsheets website as close to the project start date as possible to ensure the most recent version of the spreadsheet is used. Avoid using previously saved versions.
- 1.4 Contact your Regional HMA PWL representative and regional IA to let them know of upcoming PWL project.
- 1.5 Consider any project staging issues that may be encountered based on project layout.
- 1.6 Review all HMA planned for the project. Each project should have a mixture use table in the misc. quantities. Verify acceptance criteria whether covered by PWL, QMP, department acceptance, or another option.
- 1.7 Discuss how all data such as HMA lab/density tests, completed spreadsheets, etc. will be shared. Email seems to work the best.
- 1.8 Follow file naming system suggested in the spreadsheets.
- 1.9 Dept. reps. should create the project PWL excel files and share with the contractor.
- 1.10 Discuss the number of staff members planned to complete testing and evaluation/inspection activities during the test strip and production. Try to maintain consistency by limiting changes to the initial staff. The dept. rep. should notify Independent Assurance (IA) of schedule and verify the contractor lab is on the WisDOT approved list of qualified labs. The current list of WisDOT approved labs can be found here: <http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/appr-prod/qual-labs.aspx>
- 1.11 Dept. rep. should verify all QC and regional testing personnel are HTCP certified for the task assigned. The current list of HTCP certifications for technicians can be found here: <https://campus.uwplatt.edu/ems/htcp-certification-lists>
- 1.12 Gauge Comparison between QC/QV should be completed as per CMM 8-15.7 on all gauges (minimum of 2 QC and 2 QV gauges for test strip) to be used on PWL projects. Contact Mike Bohn if all gauges do not compare.
- 1.13 Regional WisDOT lab staff, dept. rep., and contractor QC staff should review and discuss the sampling and testing processes.
- 1.14 The contractor should consider split sample comparison testing using test batches prior to construction of the test strip if the design mix is unfamiliar.

- 1.15 If the contractor feels there may be issues due to re-heating of a sample it should be addressed with the department before the test strip. If there are reheating concerns, the department will always reheat the QV samples from cold in order to maintain consistency.
- 1.16 Complete a pre-pave meeting and discuss issues as well as the plan for the test strip and production. Random numbers for regular production should be submitted to project personnel at this time. Submit the test strip start time and date to the department in writing at least 5 calendar days in advance of construction of the test strip. Chain of command and data transfer expectations should be determined during this meeting. Develop a communication plan covering frequency and timeliness for sharing test data and spreadsheet results.
- 1.17 Discuss the plan for determining ignition oven correction factors in accordance with CMM 8-36. The contractor is required to send mix to the regional lab at least 10 days prior to production.

2. TEST STRIP PLANNING

- 2.1 Review the location and the number of test strips required in the proposal.
- 2.2 The test strip location(s) needs to be in an area of mainline (travel lane) that will allow for representative rolling patterns to be established.
- 2.3 Establish a date for the test strip and communicate changes to this date with dept. rep., Regional HMA QV rep, BTS, and contractor staff to ensure preparedness by all parties. Refer to the HMA PWL Test Strip STSP for required notification timeframe. Follow the appropriate chain of communication as outlined in the WisDOT Standard Specification, Timely Decision Making Manual, and CMM.
- 2.4 The contractor should communicate the exact location and approximate planned tonnage of the test strip(s).
- 2.5 It is recommended that contractors and dept. reps. complete the 4 gauge nuclear density gauge comparison at least one day before the test strip begins. The project reference site should also be established at this time. Times and tolerances for gauge comparison and reference site information can be found in CMM 8-15.7.
- 2.6 Regional and contractor lab personnel should ensure all testing and sampling equipment is in working order prior to test strip production. Communicate any change in lab equipment during the remainder of the project.
- 2.7 Coring process should be discussed. Review specifics such as grout material, use of ice, and timing of operations.
- 2.8 The dept. rep. is responsible for establishing random numbers and test locations for the test strip portion of the PWL project (both lab and field). These are not to be shared with the contractor. Dept. reps. should be onsite (both in the lab and field) to provide the contractor with random test locations at the appropriate tonnage or location as they become available.

- 2.9 The dept. rep. should use the anticipated test strip stations to determine the random test locations. This estimated stationing/length is used to calculate the random numbers for the two density zones.
- 2.10 Refer to the “Project Info & Instructions” tab of the HMA PWL TEST STRIP excel file for guidance on individual responsibilities and for random number calculations.

3. MAIN PRODUCTION PLANNING

- 3.1 Shoulders paved integrally during paving of mainline are not eligible for PWL or QMP density incentives. For PWL, they will be included in the mix tonnage tested at the lab during production. Density on the shoulder is only tested for acceptance by the department using random numbers according to CMM 8-15.
- 3.2 The contractor is responsible for preparing lots/sublots and QC random numbers for all regular PWL production and submitting to the dept. rep. before the pre-pave meeting. The dept. rep. will use the accepted lots/sublots to prepare the QV random numbers.
- 3.3 When preparing lot/sublots for density testing, ensure exceptions (such as bridges and station equations) are considered so subplot lengths are 1500 feet except at the end of the project.
- 3.4 The test strip area can be included in the main density lot/sublot layout. Any random tests that fall in the test strip area will be eliminated by both QV and QC during main production density testing.

II. PWL Test Strip

1. DENSITY/CORING

- 1.1 Five test locations will be selected within each zone for testing/coring. Locations are staggered across the entire lane and do not include shoulders (staggering only applies to the test strip). A 50-foot stagger between testing locations was established to accommodate the use of multiple gauges simultaneously.
- 1.2 Density zones and test locations should not be disclosed to the contractor until all rolling operations for each zone is complete. The dept. rep. will layout the two zones in which gauge/core correlation is to be performed.
- 1.3 Outside locations should be 1.5 feet from the center of the gauge to the edge of the lane on both sides.
- 1.4 The dept. rep. should ensure all required data is documented on the appropriate spreadsheet and that photos are taken of each of the ten core/gauge locations to ensure numbers are correctly recorded. The dept. rep. should also verify the accuracy of the test data and monitor all core related activities (marking, sawing, and extraction.)
- 1.5 The dept. rep. will ensure collection of density count, wet density and a tentative (uncorrected) maximum density percent.
- 1.6 Cores should be taken from the center of the gauge footprint.
- 1.7 Cores must be taken before the pavement is open to traffic.
- 1.8 Proper cooling of the mat is necessary prior to cutting cores to prevent damage. Ice can be placed on the mat at core locations to speed the cooling process.
- 1.9 Ensure that markings applied to pavement cores prior to cutting remain legible. Only the gauge identification and raw readings should be written on the pavement.
- 1.10 Cores should be inspected immediately after extrusion. Cores should be protected to maintain integrity.
- 1.11 If cores are damaged, dept. rep. should immediately be notified and a replacement core will be taken adjacent to the damaged core from the same footprint. If core damage is encountered during transport/cutting or after the project is opened to traffic, communication with the dept. rep. is essential to determine an acceptable course of action.
- 1.12 Dept. reps. should make sure there is security (both in transport and storage) for the cores until they are tested, whether that be immediately after the test strip or subsequent day if agreed upon between the dept. rep. and contractor.
- 1.13 Department supplied concrete cylinder molds should be used to transport cores. Cores should be placed upside down (flat surface to bottom of cylinder mold), one core per mold, and stored upright. Do not place cores on top of each other.
- 1.14 Dept. rep. should verify the contractor is sawing at the interface of the layer if applicable. Rolling the cores on the ground can help to locate the interface.
- 1.15 Cores should first be dried with the Core-Dry machine prior to testing for in-place density at the contractor's lab.
- 1.16 Upon completion of core testing, the dept. rep. should transport the cores to the regional lab for further testing as needed.

2. MIXTURE PRODUCTION

- 2.1 Three lab samples will be randomly selected by the dept. rep. from each *third* of the test strip tonnage, excluding the first 50 tons. Refer to the “Project Info & Instructions” tab of the HMA PWL TEST STRIP excel file for random number calculations.
- 2.2 Sample sizes should adhere to those established in CMM 8-36.
- 2.3 Dept. rep. will be at the asphalt plant prior to and during sampling to ensure proper splitting procedures are followed and to see that split portions of test strip lab samples are delivered to the regional lab in a timely fashion for testing.

3. DATA ENTRY AND ACCEPTANCE

- 3.1 Test Strip data should be entered into a recently-downloaded HMA PWL Test Strip Spreadsheet located here:
<https://awpkb.dot.wi.gov/Content/constr/Pantry/StatewideXLS.htm>
- 3.2 Instructions are contained on the “Info & Instructions” tab of the spreadsheet.
- 3.3 The total tonnage used for Air Void pay adjustment calculations should be reflected on truck tickets collected during the time of the test strip paving.
- 3.4 The test strip spreadsheet will automatically calculate the density incentive based on the stationing completed for an acceptable test strip.
- 3.5 The Department, IA, and contractor should investigate any time there is a consistent difference between labs greater than 0.008 on the Gmm and/or greater than 0.010 on the Gmb. If there are comparison issues, review HMA round robin data to compare the contractor and regional lab equipment and identify and discuss potential issues based on this data.
- 3.6 If more than one test strip is required due to a failing test strip a second test strip file should be created and both files must be kept.
- 3.7 Acceptable test strip parameters are identified in the HMA PWL Test Strip STSP under C.2.3 Test Strip Approval and Material Conformance. The dept. rep. will determine approval/rejection of the test strip within twenty-four hours (only includes working days as defined in standard spec 101.3) of the start of the test strip. The dept. rep. should communicate test strip acceptance in writing. Refer to the *PWL Test Strip Acceptance Checklist* below for further guidance.
- 3.8 If the mixture tests on the Split Sample Comparison tab do not compare, the air void and density results will not be displayed. In order to display what the results are, the tests from the QC or QV can temporarily be entered into the BTS results area. This does not mean that BTS testing is not needed. That should be determined by the Regional PWL rep and the BTS HMA unit.

4. PWL TEST STRIP ACCEPTANCE CHECKLIST

YES NO FROM PWL STSP

Conform to the following limits based on individual QC and/or QV test results (tolerances based on initial JMF/mix design):

- 37.5-mm +/- 8.0
- 25.0-mm +/- 8.0
- 19.0-mm +/- 7.5
- 12.5-mm +/- 7.5
- 9.5-mm +/- 7.5
- 2.36-mm +/- 7.0
- 75- μ m +/- 3.0
- Asphaltic content in percent - 0.5
- Air Void -1.5 & +2.0
- VMA in percent (from minimum) - 1.0*
- Maximum specific gravity +/- 0.024
- Individual Core Density (from density target) - 3.0%

FROM HMA PWL TEST STRIP SPREADSHEET

- PWL of density ≥ 75 from DENSITY PAY FACTOR TAB
- Gmm Xd Mean ≤ 0.012 from SPLIT SAMPLE COMPARISON TAB
- Gmb Xd Mean ≤ 0.012 from SPLIT SAMPLE COMPARISON TAB
- PWL of voids ≥ 75 from AIR VOIDS PAY FACTOR TAB

For any "NO" marked above please contact the proper regional PWL representative.

*Although the VMA conformance limit is -1.0 for both HMA PWL Test Strip and Production, HMA PWL Production has an action limit of -0.5 for VMA. If the VMA of the HMA PWL Test Strip is more than -0.5 of the JMF adjustments should be made prior to HMA PWL Production.

III. PWL Production

1. DENSITY

- 1.1. Full PWL production is not to start until the test strip has been completed and determined to be acceptable by the dept. rep. in writing.
- 1.2. There should not be breaks or gaps in the entered density testing data in the production spreadsheet. All tests should be entered chronologically as they are paved.
- 1.3. Footprint testing should be performed by the QC and QV at the beginning of the shift and at other times as deemed appropriate. One option is for the QC to use the QV locations for the footprint testing.
- 1.4. Footprint testing should be recorded in the appropriate location on the HMA PWL Production Spreadsheet.

2. MIXTURE PRODUCTION

- 2.1 Test results and data entry should be reviewed by the dept. rep. and shared with the contractor daily to ensure issues are not overlooked.
- 2.2 Discuss QC/QV sample splitting. QC and QV will test splits of the same material.
- 2.3 If a QC random sample has already been taken from the subplot where the QV sample is to be taken, the QC result for that subplot will be discarded and replaced by the split sample from the QV test.
- 2.4 If there are any comparison issues, the dept. rep. should communicate this immediately to all parties.
- 2.5 It is not always practical for the regional lab to run every volumetric sample hot. If a concern regarding the reheating of samples was identified before the project started, the QV samples will be allowed to cool and then reheated prior to testing in all cases. This should be documented by the QV tester.

3. DATA ENTRY AND ANALYSIS

- 3.1. Production data should be entered into a recently-downloaded HMA PWL Production Spreadsheet located here:
<https://awpkb.dot.wi.gov/Content/constr/Pantry/StatewideXLS.htm>
- 3.2. Instructions are contained on the “Info & Instructions” tab of the spreadsheet.
- 3.3. The dept. rep. will create one main PWL spreadsheet per mix for each layer. All density and lab test data should be on the same file. This file is to be kept up to date by the dept. rep.
- 3.4. The dept. rep. should enter test data daily into the appropriate PWL excel files. It is preferred that contractor data is shared in the appropriate PWL excel file so the department can simply copy and paste values of the contractor data into their final spreadsheet.
- 3.5. The dept. rep. should verify that all QV data is shared daily with the contractor.
- 3.6. PWL density data should not be entered into the Atwood system at this time. However, all density acceptance testing data for non-mainline pavement should be entered into the Atwood System.

- 3.7. For mixture testing, all department QV testing should be entered into the Atwood system. A note in the remarks that this is a PWL project should be made. No QC mixture testing should be entered at this time.
- 3.8. When the paving is completed for a contract, the actual tonnage placed should be entered into the production spreadsheet. The sublots should not all be 750 tons. Also for density, the actual length of the sublots paved should be entered. The sublots should not all be 1500 LF,

IV. PWL Project Random Number Generation Guidelines

1. ADDITIONAL GUIDANCE

- 1.1 Lots and sublots will be calculated in advance for the entire project with exceptions such as bridges and gaps being excluded. Send lot/sublot layout to BTS HMA unit for optional cursory review.
- 1.2 Although structures such as bridges are not tested for density, there should not be gaps in the density data spreadsheet. i.e. all sublots should have 3 QC and 1 QV tests.
- 1.3 All sublots should be 1500 linear feet when possible except at the end of the project if an odd length of material is leftover.
- 1.4 Any location outside of the mainline travel lane will be tested as DOT acceptance for density unless specified otherwise in the contract.
- 1.5 Random numbers will be calculated for the sublots in the entire expected project paving area including the test strip.
- 1.6 The test strip and production test locations are analyzed separately. Any random test locations within the test strip should not be tested or entered in the main production testing spreadsheet.
- 1.7 Density testing will be completed at random number test locations once all rolling processes have finished. The contractor needs to communicate clearly and immediately when an area is completed.
- 1.8 The density data will be recorded in the PWL Production spreadsheet for analysis in chronological order as the sublots are paved. The sublots should appear as they are paved regardless of label (i.e. 1, 2, 13, 12, 3).
- 1.9 The first 15 QC tests taken will be entered in as lot 1 and so on. The QV tests from the respective QC sublots will be entered in the same subplot.

V. Frequently Asked Questions – WisDOT PWL

Pre-Test Strip/Planning

Q: Is there a pay adjustment for asphalt content in a test strip?

A: No, there is no pay adjustment for asphalt content in the test strip, it is pass or fail based off of whether each individual test is within acceptance limits.

Q: Are we still required to perform gauge comparisons on PWL projects?

A: The comparisons should still be conducted and should be completed at least one day before the test strip. If the 4 gauges do not compare, contact Mike Bohn, BTS RSO.

Q: What times should be used for reference blocks, standard counts, reference site, footprint tests, etc?

A: Generally, all reference block testing completed before the project should use the current 4 minute tests while density testing after the project begins should go to the 2 or 3 - 1 minute tests. This will reduce confusion of switching the testing times on the gauges back and forth. The 1 minute readings will contain at least 2 1-minute scans with rotating the gauge 180 degrees, and a 3rd reading if the first two differ by more than 1.0 pcf in the same orientation as the first reading. Standard (poly) blocks are always run at 4-minutes both at the lab and on the mat.

Q: When a Test Strip varies from 750 tons, how does this impact the sampling intervals?

A: For the mix tests, divide the total by 3 and the first interval will not be taken in the initial 50 tons. For density sites, the 2 sites will be evenly split between the total test strip length. These calculations are automated within the HMA PWL Test Strip Spreadsheet.

Q: What is to be done about shoulder paved integrally? How are air voids and density handled?

A: Integral shoulders are paved with the same mix, meaning this mixture tonnage is accounted for during production and held to the same PWL requirements for Gmm & Gmb sampling & testing. Non-mainline paving with this “PWL mix” will be tested for density by the department for acceptance only, with no incentives applied. Density testing of shoulders requires separate random numbers from the travel lane. Correction factors are not applied to acceptance density testing. Acceptance density tests are to be entered in the Atwood system.

Q: What about ignition oven correction factors & testing? Where do I enter Ignition Oven burn-off results?

A: Ignition oven correction factors are to be determined according to CMM 8-36. AC% is being tested and used for pay adjustment on all PWL projects. Data is entered into the AC% tab of the PWL spreadsheets. Ignition oven printouts are “source” documents and should be maintained according to CMM 8-36.

Q: Must there be 4 gauges on the PWL project the entire time?

A: Two gauges are needed by each QC & QV at the time of the test strip only. The secondary/backup gauge doesn't need to be on the project after completion of the test strip but must be available if needed.

Q: Is QV testing materials hot or reheated?

A: Since it is not always practical for QV to run every sample hot, it should be anticipated that the QV may reheat samples. If there is a concern with testing results from reheating the mix, it is recommended the region lab reheat all QV samples for consistency. It is the Contractor's responsibility to know if the mix design is susceptible to changing volumetrics from sample reheating.

Q: What additional tasks are needed on site, compared to a typical HMA job?

A: During the test strip, the dept. rep. is responsible to lay out the core/gauge locations, ensure no offsets are entered into nuclear gauges, observe coring & core-hole filling, maintain possession of cores, and observe QC testing of the cores.

Q: What do I do with the QC sample when a QV sample is taken in the same subplot?

A: If QC mix sample test data has already been collected for a subplot where a QV sample is to be taken, the previously collected QC test result from that subplot will be discarded. Both QC and QV tests should be run and recorded on the QV split sample material from the subplot. (e.g. if a QC sample was collected and tested at 400 tons and a QV sample is then taken at 700 tons of the same subplot, the QC test result from 400 tons is discarded. QC and QV tests are conducted on the material taken at 700 tons and the results are reported.)

Q: What is defined as mainline?

A: Mainline is generally defined as the driving lane and is typically 12 feet wide. Any passing lane, ramp, turn lane, or auxiliary lane greater than 1500 feet may also be designated for PWL density. This should be defined by the plans.

Test Strip

Q: Can you provide additional clarification on the Test Strip density zones? When, where, and whom should be laying these out? Does it matter which side of the lane I begin on? What data is required for each gauge during the test strip?

A: The density zones should not be disclosed to the contractor/roller operators. Do not layout density/core test sites until rolling is completed and cold roller is beyond the entirety of the zone. Sites are evenly staggered transversely across the mainline driving lane, and do NOT include shoulders. The outer locations should be 1.5-feet from the center of the gauge to the edge of lane on both sides. Each test site within each zone should be spaced 50 feet apart longitudinally. This staggering layout is ONLY applicable to the test strip. All mainline density locations after test strip (during PWL production) should have a longitudinal- as well as transverse-random number to determine location. The HMA PWL Field Density Worksheet should be populated during the test strip as well as main production. This ensures collection of Density Count, Wet Density, and a tentative (uncorrected) % Max Density. The dept. rep. should be entering the data compiled in field worksheets into the appropriate spreadsheet (PWL Test Strip or PWL Production) and can cross-reference field photos. Photos should be taken of each of the 10 core/gauge locations of the test strip. This should include gauge readings (pcf) and a labelled core within the gauge footprint. If a 3rd reading is needed, all 3 readings should be recorded and documented. Only raw readings in pcf should be written on the pavement during the test strip, with a corresponding gauge ID/SN in the following format:



Q: When must the cores be cut & tested?

A: Cores must be taken before the pavement is open to traffic. Cores are cut under the observation of a dept. rep. Relabel each core immediately after extruding or ensure that labels applied to pavement prior to cutting remain legible. The layer interface should also be marked immediately following extrusion. Cores should be cut at this interface, using a saw capable of cutting full width (150mm) cores, to allow for density measurement of only the most recently placed layer. Cores should be protected from excessive temperatures and direct sunlight. Also make sure there is security (both in transport and storage) for the cores until they are tested, whether that be immediately after the test strip or subsequent day if agreed upon between the dept. rep. and Contractor. Use of concrete cylinder molds works well to transport cores. Cores should be placed upside down (flat surface to bottom of cylinder mold) in the molds, one core per mold, cylinder molds stored upright, and ideally transported in a cooler. Cores should first be dried with the Core-Dry machine prior to testing for in-place density at the contractor's lab.

Q: What if cores are damaged?

A: If a core is damaged at the time of extracting from pavement, a replacement core should be taken immediately adjacent to the damaged core from the same footprint. If a core is damaged during transporting, etc., the department should be notified immediately so the appropriate course of action can be determined. Coring after traffic is on the pavement should be avoided.

Data Entry

Q: I am confused about what tonnages should be entered for density vs air voids. Can you clarify?

A: Test strips are to be approximately 750 tons, but can vary if there is justification (i.e. to place between bridges without inserting another construction joint). The plant is to produce the anticipated tonnage, which should be reflected on truck tickets collected during the time of the test strip paving. This total tonnage from truck tickets is entered in the HMA PWL Test Strip Spreadsheet and is used for air void pay adjustment calculations. The dept. rep. should use the anticipated test strip tonnage to determine approximately how far the test strip will reach. This estimated stationing/length is used in conjunction with pavement thickness and paving width, including shoulder to calculate the random numbers for the two zones. The actual length after the test strip is completed will be entered in the HMA PWL Test Strip Spreadsheet and is used to calculate the tonnage used for density pay.

Q: Who approves the test strip? Who verifies the data?

A: The dept. rep. should be in direct communication with the Contractor and communicate on what is required to proceed. The dept. rep. is encouraged to seek guidance from the Regional HMA PWL representative who may seek additional input from BTS where needed. A similar chain of communication should be used in determining accuracy & acceptance of entered data.

Q: What do I do about project staging? Is each stage to be treated separately?

A: PWL is designed to monitor the consistency of the mix and construction over the entirety of a project, whether staged or not, therefore they are not treated separately. Depending on the amount of staging, this may impact project selection for PWL.