

# State of Wisconsin



## HMA PWL Test Strip Spreadsheet Instruction Manual

2025 Edition

## **1. Disclaimer**

This document is to be used as an instructive guide for the HMA PWL Test Strip Spreadsheet and to answer frequently asked questions of Regional Technical Services Section (TSS) and those acting as Department Representatives. It is not a substitute for reading and understanding HMA Pavement Percent Within Limits (PWL) specifications.

If there is a question about dispute resolution or data entry that is not covered in this document, please contact the Regional PWL Representative. If consulting BTS is recommended by this document or the HMA PWL Test Strip Spreadsheet, that contact should be made by TSS Staff.

The HMA PWL Test Strip Spreadsheet is designed to simplify the recording and analysis of contractor Quality Control (QC) and department Quality Verification (QV) data related to pavement density and air voids used for HMA test strip pay adjustment.

The Plans, Standard Specifications, and Special Provisions ALWAYS supersede this document, even in cases where this document may contradict those provisions.

## 2. Table of Contents

1. Disclaimer.....	i
2. Table of Contents .....	ii
3. General.....	1
4. Project Info & Instructions .....	2
5. Split Sample Comparison .....	4
6. Core Data.....	7
7. AC % Data.....	12
8. Mix Acceptance .....	15
9. Air Voids Pay Factor.....	17
10. Density Pay Factor.....	18
11. Test Strip Summary .....	19
12. Gauge-Core Variability .....	22
13. QC-X / QV-X Density Worksheets.....	24
14. QC-X / QV-X Correlation .....	25
15. Appendix .....	26
15.1 t-Testing .....	26
15.2 Enabling Macros (Red Banner) .....	27

### 3. General

- A copy of this instruction manual is available within the PWL Test Strip Spreadsheet on the *Project Info & Instructions* worksheet. Simply double click the button “PWL Test Strip Manual” to access them from within the spreadsheet.
- The PWL Test Strip Spreadsheet should be filled out and completed by the Department Representative.
- The *Project Info & Instructions* worksheet must be filled out first prior to entering test results. Some worksheets will not appear until the required project information has been entered.
- Worksheets tab colors indicate the following:
  - Green – Worksheets that require test results to be entered.
  - Red – Worksheets that only present results; no data entry is required in these sheets.
- Cells that are canary/yellow colored are data entry fields.
  - It is essential that no blank spaces are entered in or after any of the information entered into the fields.
  - When copy/pasting, only use “Paste Values”. If you use the hotkey combination, CTRL+V, values will be pasted automatically.

#### 4. Project Info & Instructions

This is the main entry point for the PWL Test Strip Spreadsheet (Figure 1). It contains fields for information about the project as well as paving information such as the mix design and pavement layer and dimensions.

The canary/yellow fields on the *Project Info and Instructions* worksheet should be filled out completely by the Department Representative prior to beginning construction. Most of the fields in the *Project Info & Instructions* worksheet (i.e.: Contract Unit Price, Lane Width, Nominal Thickness, JMFs, etc.) are required for the worksheet to function correctly. The Test Strip Type (Combined Density and Volumetrics, Density-Only, and Volumetric-Only) must be selected to hide or reveal the correct worksheets for data entry. Project information used in all other worksheets within the spreadsheet are referenced from the *Project Info & Instructions* worksheet and can only be changed from this worksheet.

At the end of the Test Strip, the Department Representative must enter the Test Strip's Final Tonnage (cell C23) and Final Length (ft., cell C24). These final values are used for the pay adjustments.

Revised 4-08-25

**Wisconsin Department of Transportation**

**HMA PWL Test Strip Spreadsheet**

**Combined Density and Volumetrics Test Strip Project Information**

Test Strip Type: ☒ Combined Density and Volumetrics ☐ Density-Only ☐ Volumetric-Only

Date Constructed:

Test Strip #:

Contract ID:

Job No./Project ID:

Route/Road:

County:

WisDOT Mix No.:

Mix Gradation:

Mix Traffic Vol:

Asphalt Binder:

Binder Designation:

Mix Type:

Contract Unit Price:

Final Tonnage:

Final Length:

Paving Width(ft.):

Lane Width(ft.):

Nominal Thickness(in.):

Estimated Tonnage:

Estimated Stations- Start:  End:

Estimated Length(ft.):

Test Strip Pavement Layer:

Underlying Layer:

Density Lower Spec Limit(%):

Project Leader:

Contractor:

JMF Gmm:

JMF AC %:

JMF AC Sp. Gr.:

JMF Gse:

Calculated Tonnage:

Calculated Length:

☐ Calculate Tonnage Based On Known Length

☐ Stations Decreasing

☐ Random Stations Locked **Generate Random Stations**

☐ Random Tonnage Locked **Generate Random Tonnage**

Density Zone #1 Center Station:

Density Zone #2 Center Station:

Random Split Sample #1 Tonnage:

Random Split Sample #2 Tonnage:

Random Split Sample #3 Tonnage:

Other/Notes:

Suggested File Name:

**Save As with Suggested File Name (Use this to save)**

**Export All Worksheets as PDF**

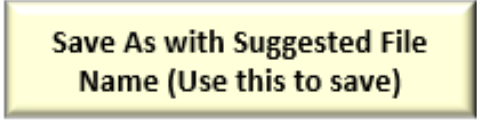


**Export Field Density Worksheets as PDF**

**PWL Test Strip Spreadsheet Instructions 2020**

**From WisDOT 250 Report/ Current JMF**

Figure 1: Project Info & Instructions Interface.

There are several buttons for worksheet functions found on the righthand side of the interface. The buttons perform the following functions:

	<ul style="list-style-type: none"> <li>• Saves the spreadsheet as a new Excel file (without overwriting old versions) with the suggested file name, including the date and time that the spreadsheet was saved.</li> <li>• This is the preferred method of saving the spreadsheet.</li> </ul>
	<ul style="list-style-type: none"> <li>• Exports the entire spreadsheet and its worksheets as a PDF.</li> </ul>
	<ul style="list-style-type: none"> <li>• Exports only the field density worksheets (QC-1, QC-2, QV-1, and QV-2 Density Worksheets) as a PDF. These can be printed and used in the field.</li> </ul>

## 5. Split Sample Comparison

This worksheet only appears when either “Combined Density and Volumetrics” or “Volumetric-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to enter the split samples’ Gmm and Gmb results as well as the results of any dispute testing, if required. The split sample comparison is a check for reasonable test result differences between labs.

The Department Representative will enter the following information from the split sample comparison testing (Figure 2):

- QC Gmms
- QV Gmms
- QC Gmbs
- QV Gmbs
- BTS Referee Gmms (if required)
- BTS Referee Gmbs (if required)

Split Sample Testing Comparison																																																																									
Date: _____		Test Strip #: _____																																																																							
Project ID: _____		Route/Road: _____																																																																							
Mix Type: _____		Layer: _____																																																																							
JMF Gmm: _____		Enter JMF Gmm.																																																																							
<p>If datasets compare and testing differences are within testing tolerance, QC data is carried into the Air Voids Pay Factor worksheet. If not, BTS will conduct referee Gmm &amp; Gmb tests and BTS data will be used for subsequent calculations.</p> <p>If QC and QV datasets do not compare, BTS referee Gmm and Gmb test data needs to be entered in the BTS Referee Gmm/Gmb Column.</p>																																																																									
<table border="1"> <thead> <tr> <th colspan="4">G<sub>mm</sub></th> <th colspan="4">BTS Vs. QC Results</th> <th colspan="2">BTS Vs. QV Results</th> </tr> <tr> <th>Split Sample Number</th> <th>Tonnage</th> <th>QC Gmm</th> <th>QV Gmm</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> <th>Degree of Freedom</th> <th>-1</th> <th>BTS Referee Gmm</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>t-test p-value</td> <td></td> <td>Prob. α</td> <td>0.010</td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="10">Split Sample Results: _____</td> </tr> </tbody> </table>										G <sub>mm</sub>				BTS Vs. QC Results				BTS Vs. QV Results		Split Sample Number	Tonnage	QC Gmm	QV Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Degree of Freedom	-1	BTS Referee Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	1					t-test p-value		Prob. α	0.010			2											3											Split Sample Results: _____									
G <sub>mm</sub>				BTS Vs. QC Results				BTS Vs. QV Results																																																																	
Split Sample Number	Tonnage	QC Gmm	QV Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Degree of Freedom	-1	BTS Referee Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean																																																															
1					t-test p-value		Prob. α	0.010																																																																	
2																																																																									
3																																																																									
Split Sample Results: _____																																																																									
<table border="1"> <thead> <tr> <th colspan="4">G<sub>mm</sub> Tolerance to JMF</th> <th colspan="2">BTS Gmm-JMF Difference</th> </tr> <tr> <th>Split Sample Number</th> <th>Tonnage</th> <th>QC Gmm-JMF Difference</th> <th>QV Gmm-JMF Difference</th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>										G <sub>mm</sub> Tolerance to JMF				BTS Gmm-JMF Difference		Split Sample Number	Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference			1						2						3																																							
G <sub>mm</sub> Tolerance to JMF				BTS Gmm-JMF Difference																																																																					
Split Sample Number	Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference																																																																						
1																																																																									
2																																																																									
3																																																																									
<table border="1"> <thead> <tr> <th colspan="4">G<sub>mb</sub></th> <th colspan="4">BTS Vs. QC Results</th> <th colspan="2">BTS Vs. QV Results</th> </tr> <tr> <th>Split Sample Number</th> <th>Tonnage</th> <th>QC Gmb</th> <th>QV Gmb</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> <th>Degree of Freedom</th> <th>-1</th> <th>BTS Referee Gmb</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td></td> <td></td> <td></td> <td>t-test p-value</td> <td></td> <td>Prob. α</td> <td>0.010</td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="10">Split Sample Results: _____</td> </tr> </tbody> </table>										G <sub>mb</sub>				BTS Vs. QC Results				BTS Vs. QV Results		Split Sample Number	Tonnage	QC Gmb	QV Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Degree of Freedom	-1	BTS Referee Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	1					t-test p-value		Prob. α	0.010			2											3											Split Sample Results: _____									
G <sub>mb</sub>				BTS Vs. QC Results				BTS Vs. QV Results																																																																	
Split Sample Number	Tonnage	QC Gmb	QV Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Degree of Freedom	-1	BTS Referee Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean																																																															
1					t-test p-value		Prob. α	0.010																																																																	
2																																																																									
3																																																																									
Split Sample Results: _____																																																																									
<p>Note: This review is a check for reasonable test result differences between labs. Due to the small sample size, &lt;20, it is possible to have two sets of data that fail the t-test (p-value), but the "test results are within testing tolerance". For such differences, if allowed by the engineer, asphalt mix production may resume as the test result differences are based on small sample sizes and consistent testing differences. In such case, if all Gmm are within Tolerance to JMF and both X<sub>d</sub> Mean are within testing tolerance QC Gmm and Gmb data will be used for analysis if the box at the right is checked and the name of the Regional PWL Rep is entered in the box below.</p> <p>It is also possible to have two-sets of test results that are so variable that the results pass the t-test (p-value), but the "test differences exceed testing tolerance". The cause of this type testing variation needs to be resolved before production of mix resumes.</p>																																																																									
<div style="text-align: right;"> <input type="checkbox"/> Failed t-test but X<sub>d</sub> Mean and Gmm All Within Tolerance-No Referee Test Needed         </div>																																																																									
<table border="1"> <thead> <tr> <th colspan="3">Air Voids %</th> </tr> <tr> <th>Contractor</th> <th>Department</th> <th>BTS</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>										Air Voids %			Contractor	Department	BTS																																																										
Air Voids %																																																																									
Contractor	Department	BTS																																																																							
<div style="text-align: right;">Revised 4-08-25</div>																																																																									

Figure 2: Split Sample Comparison data entry fields.

This worksheet checks for four (4) conditions to be met:

1. The paired t-test p-value for both Gmm and Gmb must be greater than alpha (0.010).
2. The Gmms for all parties must not be more than  $\pm 0.024$  from the JMF Gmm.
3. The Average Difference (X<sub>d</sub> Mean) between both QC and QV Gmms and Gmbs must be less than or equal to 0.012.
4. Individual QC and QV air voids tests must meet the acceptance limits ( $1.5\% \leq V_a \leq 5.0\%$ ).

Notes:

- BTS Referee Testing is only required if Condition 1 AND 3 are NOT MET, OR Condition 4 is NOT MET.
  - In the event BTS Referee testing is required, the BTS Referee cells (column K) will change to a canary/yellow color and say “BTS Result”. Enter the results of the BTS Referee testing in these cells (Figure 3).
- If Condition 1 is NOT MET but Condition 3 IS MET, then no BTS referee testing is required.
  - In the event this situation occurs. Select the checkbox next to *Failed t-test but Xd Mean and Gmm All Within Tolerance – No Referee Test Needed* and enter the Regional PWL Representative Name that reviewed and approved the results in the field that appears below the check box (Figure 4).

Split Sample Testing Comparison										If datasets compare and testing differences are within testing tolerance, QC data is carried into the Air Voids Pay Factor worksheet. If not, BTS will conduct referee Gmm & Gmb tests and BTS data will be used for subsequent calculations. If QC and QV datasets do not compare, BTS referee Gmm and Gmb test data needs to be entered in the BTS Referee Gmm/Gmb Column.																								
Date: 8/29/2024		Test Strip #: 1		Project ID: USH 51		Route/Road: Upper																												
Mix Type: 4-MT-5B-28S		JMF Gmm: 2.445																																
G <sub>mm</sub>										BTS Vs. QC Results																								
Split Sample Number	Tonnage	QC Gmm	QV Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	0.017	Degree of Freedom	2	BTS Referee Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean																					
1	198	2.443	2.459	0.016	t-test p-value	0.001	Prob. α	0.010	BTS Result	t-test p-value		t-test p-value																						
2	338	2.439	2.457	0.018	Test differences exceed testing tolerance.				BTS Result																									
3	690	2.439	2.456	0.017	Split Sample Results: Do not Compare				BTS Result																									
G <sub>mm</sub> Tolerance to JMF										BTS Gmm-JMF Difference																								
Split Sample Number	Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference	Gmms are within JMF Acceptance Limit.																														
1		0.002	0.014																															
2		0.006	0.012																															
3		0.006	0.011																															
G <sub>mb</sub>										BTS Vs. QC Results																								
Split Sample Number	Tonnage	QC Gmb	QV Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	0.002	Degree of Freedom	2	BTS Referee Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean																					
1		2.367	2.372	0.005	t-test p-value	0.250	Prob. α	0.010	BTS Result	t-test p-value		t-test p-value																						
2		2.368	2.370	0.002	Test differences within testing tolerance.				BTS Result																									
3		2.364	2.364	0.000	Split Sample Results: Datasets Compare				BTS Result																									
Note:										<input type="checkbox"/> Failed t-test but Xd Mean and Gmm All Within Tolerance – No Referee Test Needed.																								
<p>This review is a check for reasonable test result differences between labs. Due to the small sample size, &lt;20, it is possible to have two sets of data that fail the t-test (p-value), but the <b>test results are within testing tolerance</b>. For such differences, if allowed by the engineer, asphalt mix production may resume as the test result differences are based on small sample sizes and consistent testing differences. In such case, if all Gmm are within Tolerance to JMF and both Xd Mean are within testing tolerance QC Gmm and Gmb data will be used for analysis if the box at the right is checked and the name of the Regional PWL Rep is entered in the box below.</p> <p>It is also possible to have two-sets of test results that are so variable that the results pass the t-test (p-value), but the <b>test differences exceed testing tolerance</b>. The cause of this type testing variation needs to be resolved before production of mix resumes.</p>										<table border="1"> <thead> <tr> <th colspan="3">Air Voids %</th> </tr> <tr> <th>Contractor</th> <th>Department</th> <th>BTS</th> </tr> </thead> <tbody> <tr> <td>3.1</td> <td>3.5</td> <td>BTS Result</td> </tr> <tr> <td>2.9</td> <td>3.5</td> <td>BTS Result</td> </tr> <tr> <td>3.1</td> <td>3.7</td> <td>BTS Result</td> </tr> </tbody> </table>										Air Voids %			Contractor	Department	BTS	3.1	3.5	BTS Result	2.9	3.5	BTS Result	3.1	3.7	BTS Result
Air Voids %																																		
Contractor	Department	BTS																																
3.1	3.5	BTS Result																																
2.9	3.5	BTS Result																																
3.1	3.7	BTS Result																																
										Revised 4-08-25																								

Figure 3: Failed t-test and Xd Mean.



Split Sample Testing Comparison																																																																										
Date: 8/29/2024		Test Strip #: 1		If datasets compare and testing differences are within testing tolerance, QC data is carried into the Air Voids Pay Factor worksheet. If not, BTS will conduct referee Gmm & Gmb tests and BTS data will be used for subsequent calculations.																																																																						
Project ID: 4-MT-58-285		Route/Road: USH 51		If QC and QV datasets do not compare, BTS referee Gmm and Gmb test data needs to be entered in the BTS Referee Gmm/Gmb Column.																																																																						
Mix Type: 4-MT-58-285		Layer: Upper																																																																								
JMF Gmm: 2.445																																																																										
<table border="1"> <thead> <tr> <th colspan="2">Split Sample Number</th> <th>Tonnage</th> <th>QC Gmm</th> <th>QV Gmm</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> <th>0.007</th> <th>Degree of Freedom</th> <th>2</th> <th>BTS Referee Gmm</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>198</td> <td>2.443</td> <td>2.449</td> <td>0.006</td> <td>t-test p-value</td> <td>0.007</td> <td>Prob. α</td> <td>0.010</td> <td></td> <td></td> <td>t-test p-value</td> <td></td> <td>t-test p-value</td> <td></td> </tr> <tr> <td>2</td> <td>338</td> <td>2.439</td> <td>2.447</td> <td>0.008</td> <td colspan="9">Test differences within testing tolerance.</td> </tr> <tr> <td>3</td> <td>680</td> <td>2.439</td> <td>2.446</td> <td>0.007</td> <td colspan="9">Split Sample Results: Do not Compare.</td> </tr> </tbody> </table>															Split Sample Number		Tonnage	QC Gmm	QV Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	0.007	Degree of Freedom	2	BTS Referee Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	1	198	2.443	2.449	0.006	t-test p-value	0.007	Prob. α	0.010			t-test p-value		t-test p-value		2	338	2.439	2.447	0.008	Test differences within testing tolerance.									3	680	2.439	2.446	0.007	Split Sample Results: Do not Compare.										
Split Sample Number		Tonnage	QC Gmm	QV Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	0.007	Degree of Freedom	2	BTS Referee Gmm	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean																																																												
1	198	2.443	2.449	0.006	t-test p-value	0.007	Prob. α	0.010			t-test p-value		t-test p-value																																																													
2	338	2.439	2.447	0.008	Test differences within testing tolerance.																																																																					
3	680	2.439	2.446	0.007	Split Sample Results: Do not Compare.																																																																					
<table border="1"> <thead> <tr> <th colspan="2">Split Sample Number</th> <th>Tonnage</th> <th>QC Gmm-JMF Difference</th> <th>QV Gmm-JMF Difference</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> <th>0.002</th> <th>Degree of Freedom</th> <th>2</th> <th>BTS Referee Gmb</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> <th>Difference (X<sub>d</sub>)</th> <th>X<sub>d</sub> Mean</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> <td></td> <td>0.002</td> <td>0.004</td> <td>0.005</td> <td>t-test p-value</td> <td>0.250</td> <td>Prob. α</td> <td>0.010</td> <td></td> <td>t-test p-value</td> <td></td> <td>t-test p-value</td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td>0.006</td> <td>0.002</td> <td>0.002</td> <td colspan="9">Test differences within testing tolerance.</td> </tr> <tr> <td>3</td> <td></td> <td></td> <td>0.006</td> <td>0.001</td> <td>0.000</td> <td colspan="9">Split Sample Results: Datasets Compare.</td> </tr> </tbody> </table>															Split Sample Number		Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	0.002	Degree of Freedom	2	BTS Referee Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	1			0.002	0.004	0.005	t-test p-value	0.250	Prob. α	0.010		t-test p-value		t-test p-value		2			0.006	0.002	0.002	Test differences within testing tolerance.									3			0.006	0.001	0.000	Split Sample Results: Datasets Compare.								
Split Sample Number		Tonnage	QC Gmm-JMF Difference	QV Gmm-JMF Difference	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	0.002	Degree of Freedom	2	BTS Referee Gmb	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean	Difference (X <sub>d</sub> )	X <sub>d</sub> Mean																																																												
1			0.002	0.004	0.005	t-test p-value	0.250	Prob. α	0.010		t-test p-value		t-test p-value																																																													
2			0.006	0.002	0.002	Test differences within testing tolerance.																																																																				
3			0.006	0.001	0.000	Split Sample Results: Datasets Compare.																																																																				
<p><b>Notes:</b></p> <p>This review is a check for reasonable test result differences between labs. Due to the small sample size, &lt;20, it is possible to have two sets of data that fail the t-test (p-value), but the <b>"test results are within testing tolerance"</b>. For such differences, if allowed by the engineer, asphalt mix production may resume as the test result differences are based on small sample sizes and consistent testing differences. In such case, if all Gmm are within Tolerance to JMF and both X<sub>d</sub> Mean are within testing tolerance QC Gmm and Gmb data will be used for analysis if the box at the right is checked and the name of the Regional PWL Rep is entered in the box below.</p> <p>It is also possible to have two-sets of test results that are so variable that the results pass the t-test (p-value), but the <b>"test differences exceed testing tolerance"</b>. The cause of this type testing variation needs to be resolved before production of mix resumes.</p>																																																																										
<p>Regional PWL Rep. Approving Split Sample Data</p> <p>Bob Seger</p> <table border="1"> <thead> <tr> <th colspan="3">Air Voids %</th> </tr> <tr> <th>Contractor</th> <th>Department</th> <th>BTS</th> </tr> </thead> <tbody> <tr> <td>3.1</td> <td>3.1</td> <td></td> </tr> <tr> <td>2.9</td> <td>3.1</td> <td></td> </tr> <tr> <td>3.1</td> <td>3.4</td> <td></td> </tr> </tbody> </table>															Air Voids %			Contractor	Department	BTS	3.1	3.1		2.9	3.1		3.1	3.4																																														
Air Voids %																																																																										
Contractor	Department	BTS																																																																								
3.1	3.1																																																																									
2.9	3.1																																																																									
3.1	3.4																																																																									
<p>Gmm Xd Mean Tolerance: 0.012</p> <p>Gmb Xd Mean Tolerance: 0.012</p>																																																																										

Figure 4: Failed t-test but Xd Mean and Gmm All Within Tolerance.

## 6. Core Data

This worksheet only appears when either “Combined Density and Volumetrics” (Figure 5) or “Density-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to enter the mainline density test results obtained by cores.

The Department Representative will enter the following information from the core density testing:

- Contractor Dry Weight (g)
- Contractor SSD Weight (g)
- Contractor Submerged Weight (g)
- Department Dry Weight (g) (if performed)
- Department SSD Weight (g) (if performed)
- Department Submerged Weight (g) (if performed)
- QC or QV Core Data Used For Analysis (option available when Department enters optional core verification results)
- Suspect Core Removal (if needed)
- Daily Average Gmm for Density-Only Test Strip Analysis (Density-Only Test Strip, Figure 6)
- PWL Production Gmm OR Non-Random Dept. Gmm collected during Density-Only Test Strip (Density-Only Test Strip, Figure 6)

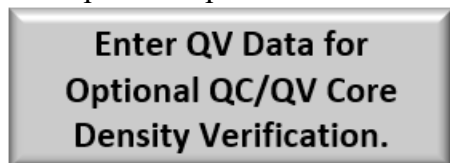
	A	B	C	D	E	F	G	H	I	K	V
1	<b>Core Data</b>										
2											
3											
4	Date:				Test Strip #:			Enter QV Data for Optional QC/QV Core Density Verification.			
5	Project ID:				Route/Road:						
6	Mix Type:	--			Layer:						
7	Gmm For Analysis:				LSL:	Enter Mix and Layer Info					
8	Gmm Source:	QC			JMF Gmm:	Enter JMF Gmm.					
9	<b>Contractor Core Density Calculations</b>										
10	Label	Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result		
11		-01+00									
12		-00+50									
13		00+00									
14		00+50									
15		01+00									
16											
17		Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result		
18		-01+00									
19		-00+50									
20		00+00									
21		00+50									
22		01+00									
23	Average:										
24											
25	<b>Note:</b>										
26	The Location Comparison Result references values on the Gauge-Core Variability worksheet comparing the core density data with each adjusted nuclear density gauge reading at each test location. "Suspect Core" is displayed										
27	under Location Comparison Result if the Location Comparison average is $\geq 1.0$ or $\leq -1.0$ this indicates a core that										
28	may be damaged. Contact the Regional PWL Representative when a "Suspect Core" is identified here or when core										
29	density values are considered questionable. <b>ONLY THE REGIONAL PWL REPRESENTATIVE CAN REMOVE A</b>										
30	<b>CORE FROM ANALYSIS.</b>										
31											
32											
33	Other/Notes:										
34											
35											
36											
37	Revised 4-08-25										
38											

Figure 5: Core Data Fields for a Combined Volumetric and Density Test Strip.

	A	B	C	D	E	F	G	H	I	K	V
1	<b>Core Data</b>								Daily Average Gmm for Density-Only Test Strip Analysis:		
2	PWL Production Gmm OR Non-Random Dept. Gmm collected during Density-Only Test Strip:										
3											
4	Date:				Test Strip #:			<div>Enter QV Data for Optional QC/QV Core Density Verification.</div>			
5	Project ID:				Route/Road:						
6	Mix Type:	--			Layer:						
7	Gmm For Analysis:	Enter Gmm Running Avg. Above			LSL:	Enter Mix and Layer Info					
8	Gmm Source:	QC			JMF Gmm:	Enter JMF Gmm.					
9	Contractor Core Density Calculations										
10	Label	Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result		
11		-01+00						Enter Gmm.			
12		-00+50						Enter Gmm.			
13		00+00						Enter Gmm.			
14		00+50						Enter Gmm.			
15		01+00						Enter Gmm.			
16											
17		Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result		
18		-01+00						Enter Gmm.			
19		-00+50						Enter Gmm.			
20		00+00						Enter Gmm.			
21		00+50						Enter Gmm.			
22		01+00						Enter Gmm.			
23											
24	Average:										
25	<b>Note:</b>										
26	The Location Comparison Result references values on the Gauge-Core Variability worksheet comparing the core density data with each adjusted nuclear density gauge reading at each test location. "Suspect Core" is displayed under Location Comparison Result if the Location Comparison average is $\geq 1.0$ or $\leq -1.0$ this indicates a core that may be damaged. Contact the Regional PWL Representative when a "Suspect Core" is identified here or when core density values are considered questionable. <b>ONLY THE REGIONAL PWL REPRESENTATIVE CAN REMOVE A CORE FROM ANALYSIS.</b>										
27											
28											
29											
30											
31											
32											
33	Other/Notes:										
34											
35											
36											
37	Revised 4-08-25										
38											

Figure 6: Core Data Fields for a Density-Only Test Strip.

The department may decide to perform optional density verification of the contractor's results. If the department performs this testing, the results can be entered by pressing the



button to reveal the data entry fields (Figure 7). Additionally, the Department Representative, at their discretion, can select which data set, QC or QV, to use for acceptance, pay adjustment, and nuclear gauge correlation.

Notes:

- It is recommended to use QV results for analysis if the *Difference in Average % Density* (cell U24) is more than 0.5%.



	A	B	C	D	E	F	G	H	I	J	K	V	
1	<b>Core Data</b>												
2													
3													
4		Date:	8/6/2024			Test Strip #:	1						
5		Project ID:				Route/Road:	STH 33						
6		Mix Type:	3-MT-58-285			Layer:	Lower						
7		Gmm For Analysis:	2.573			LSL:	91.0			Enter QV Data for Optional QC/QV Core Density Verification.			
8		Gmm Source:	QC			JMF Gmm:	2.567						
9		<b>Contractor Core Density Calculations</b>											
10		Label	Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result	Remove Core Data From Analysis?		
11		LL-1	10+38	1.5	941.0	941.7	548.6	2.394	93.0	Suspect Core (1.1%)	<input type="checkbox"/> Remove Core 1		
12		LL-2	10+88	3.5	1,330.5	1,331.7	783.7	2.428	94.4		<input type="checkbox"/> Remove Core 2		
13		LL-3	11+38	6.0	1,245.9	1,246.7	738.3	2.451	95.3		<input type="checkbox"/> Remove Core 3		
14		LL-4	11+88	8.5	993.9	994.7	588.1	2.444	95.0		<input type="checkbox"/> Remove Core 4		
15		LL-5	12+38	10.5	1,336.4	1,338.6	780.9	2.396	93.1		<input type="checkbox"/> Remove Core 5		
16													
17													
18			Random Station	Offset from CL	Dry	SSD	Submerged	QC Core Bulk Density	QC Density % of Gmm	Location Comparison Result	Remove Core Data From Analysis?		
19		LL-6	25+11	1.5	1,331.3	1,332.7	773.2	2.379	92.5	Suspect Core (-1.6%)	<input type="checkbox"/> Remove Core 6		
20		LL-7	25+61	3.5	1,199.3	1,199.8	699.3	2.396	93.1	Suspect Core (-1.8%)	<input type="checkbox"/> Remove Core 7		
21		LL-8	26+11	6.0	1,183.3	1,184.2	698.8	2.438	94.8		<input type="checkbox"/> Remove Core 8		
22		LL-9	26+61	8.5	1,146.8	1,147.8	671.4	2.407	93.5		<input type="checkbox"/> Remove Core 9		
23		LL-10	27+11	10.5	1,110.7	1,111.7	645.7	2.383	92.6		<input type="checkbox"/> Remove Core 10		
24			Average:						2.412	93.7			
25		<b>Note:</b>	The Location Comparison Result references values on the Gauge-Core Variability worksheet comparing the core density data with each adjusted nuclear density gauge reading at each test location. "Suspect Core" is displayed under Location Comparison Result if the Location Comparison average is $\geq 1.0$ or $\leq -1.0$ this indicates a core that may be damaged. Contact the Regional PWL Representative when a "Suspect Core" is identified here or when core density values are considered questionable. <b>ONLY THE REGIONAL PWL REPRESENTATIVE CAN REMOVE A CORE FROM ANALYSIS.</b>									PWL Rep Suspect Core Review	Hide Core Review
26													
27													
28													
29													
30		Other/Notes:											
31													
32													
33													
34													
35													
36													
37													
38													

Figure 8: Suspect Core Review Interface.

## 7. AC % Data

This worksheet only appears when either “Combined Density and Volumetrics” or “Volumetric-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to enter the results of the asphalt content testing.

The Department Representative will enter the following information from the asphalt content testing ():

- QC AC%
- QV AC%
- BTS Referee AC% (if required)

Asphalt Content (AC) % Testing Data						
Date:		Test Strip #:				
Project ID:		Route/Road:				
Mix Type:		Layer:				
		JMF AC%: Enter JMF Binder AC%.				
AC Binder %						
Split Sample Number	Tonnage	QC AC%	QV AC%	Difference QC & QV	BTS Referee AC%	
1						
2						
3						
AC% below calculated from the JMF Gse, JMF AC Sp Gr., and each Split Sample's GMM for reference only.						
Split Sample Number	Tonnage	QC Calc AC%	QV Calc AC%	Difference QC & QV	BTS Calc AC%	
1						
2						
3						
Enter the JMF Gse and AC Sp. Gr. on Project Info & Instructions Tab.						
<b>Note:</b> Enter JMF AC %, JMF Gse, and JMF AC Specific Gravity on the Project Info & Instructions tab. No pay adjustment will be assessed based on AC % test results. However, results of AC % testing will be referenced when determining test strip approval.						

Revised 4-08-25

Figure 9: AC% Data Fields.

In the event there are unacceptable individual asphalt contents, then the corresponding BTS Referee AC% cell(s) will turn canary/yellow and will say “Enter BTS AC%.” Enter the results of the BTS Referee Testing in the corresponding cell(s). (Figure 10)

In the event the *Split Sample Comparison* requires BTS Referee Testing, all of the BTS Referee AC% cells will turn canary/yellow and will say “Enter BTS AC%.” Enter the results of the BTS Referee Testing in the corresponding cells. (Figure 11)

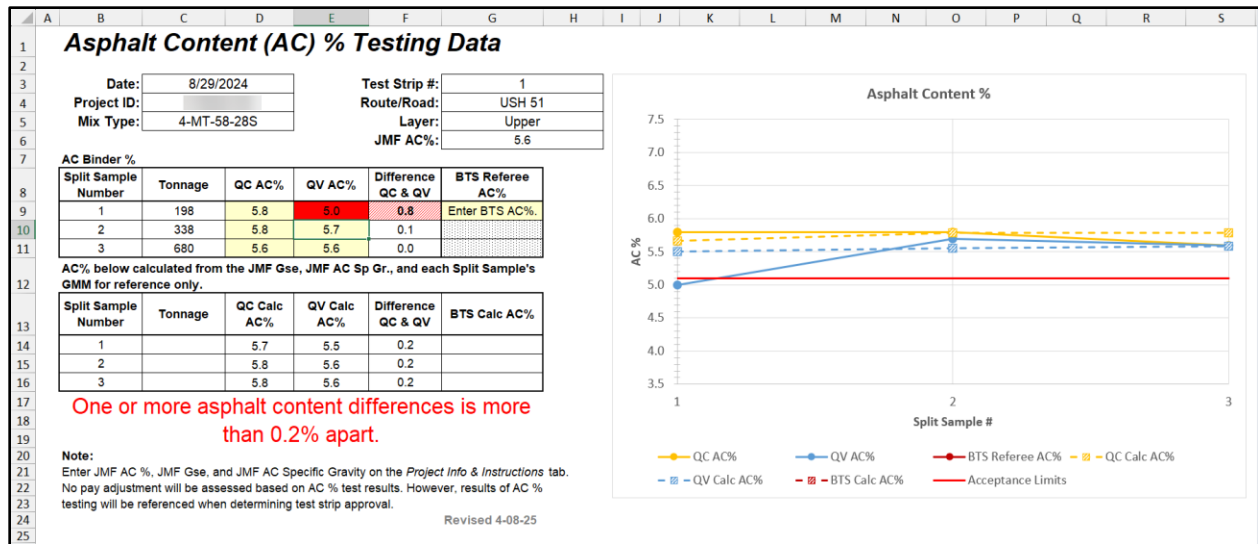


Figure 10: Individual Unacceptable Asphalt Contents.

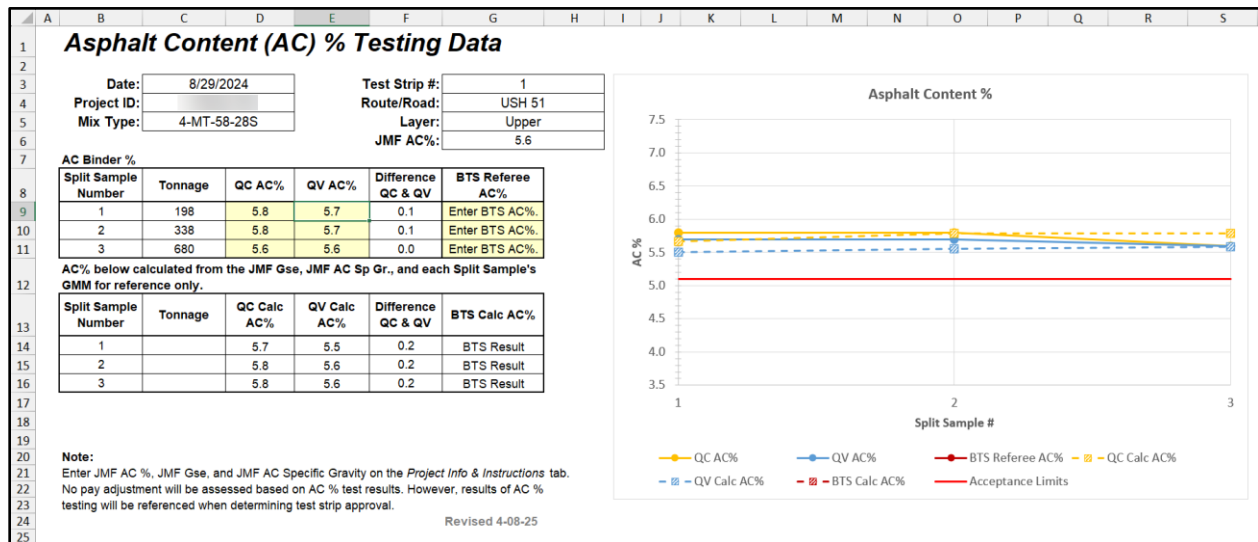


Figure 11: Split Sample Comparison Requires BTS Referee Testing.

Additionally, the table below the data entry table shows calculated asphalt contents that are calculated using each party's Gmm in the following equation:

$$\text{Calculated AC (\%)} = 100 * \frac{G_{AC,JMF}}{G_{mm,x}} * \frac{G_{se,JMF} - G_{mm,x}}{G_{se,JMF} - G_{AC,JMF}}$$

Where:

$G_{AC,JMF}$  = Asphalt Cement JMF Specific Gravity

$G_{se,JMF}$  = JMF Effective Stone Specific Gravity

$G_{mm,x}$  = Measured Gmm for Split Sample X (QC or QV)



Individually measured asphalt contents and calculated asphalted contents for both parties as well as the acceptance limits are drawn on the chart to the right of the data entry fields. Measured values are shown in solid-colored lines and markers, where QC values are yellow, QV values are blue, and BTS Referee values are Red. Calculated values for each party are also plotted using the same colors as measured values but using dashed lines and hashed markers instead.

## 8. Mix Acceptance

This worksheet only appears when either “Combined Density and Volumetrics” or “Volumetric-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to accept the mixture split sample gradations and VMAs.

The Department Representative will check the box for each measured property that meets the acceptance limits for each split sample (Figure 12).

	A	B	C	D	E	F	G	H	I
1	<b>Mix Acceptance Results</b>								
2	Test strip HMA mixture shall conform to the following				Confirm that the mixture conforms to acceptance limits by checking the boxes below.				
3	limits based on individual QC and QV test results								
4	(tolerances based on most recent JMF):								
5									
6					Split Sample				
7		Item	Acceptance		1	2	3		
8		% passing given Sieve:	Limits		Check All	Check All	Check All		
9		37.5-mm	+/- 8.0		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
10		25.0-mm	+/- 8.0		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
11		19.0-mm	+/- 7.5		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
12		12.5-mm	+/- 7.5		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
13		9.5-mm	+/- 7.5		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
14		2.36-mm	+/- 7.0		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
15		75-µm	+/- 3.0		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
16		VMA in Percent <sup>[1]</sup>	-1.0		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
17									
18			Test Result						
19									
20					Clear All				
21		<sup>[1]</sup> VMA limits based on minimum requirement for mix							
22		design nominal maximum aggregate size in table 460-1.							
23									
24		Revised 4-08-25							

Figure 12: Mix Acceptance Checklist

Notes:

- The checklist applies to QC and QV/BTS results. If any party does not meet the acceptance limit for a property in the list, the checkbox should not be marked.
  - QV/BTS may optionally test the gradation.

If any of the requirements are not met, the split sample not meeting the requirement will be flagged with “Fail”, otherwise it will be flagged with “Pass” (Figure 13).

	A	B	C	D	E	F	G	H	I
1	<b>Mix Acceptance Results</b>								
2	Test strip HMA mixture shall conform to the following				Confirm that the mixture conforms to acceptance limits by checking the boxes below.				
3	limits based on individual QC and QV test results								
4	(tolerances based on most recent JMF):								
5									
6					<div style="text-align: center;">Split Sample</div> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">1</div> <div style="text-align: center;">2</div> <div style="text-align: center;">3</div> </div>				
7		Item	Acceptance						
8		% passing given Sieve:	Limits						
9		37.5-mm	+/- 8.0						
10		25.0-mm	+/- 8.0						
11		19.0-mm	+/- 7.5						
12		12.5-mm	+/- 7.5						
13		9.5-mm	+/- 7.5						
14		2.36-mm	+/- 7.0						
15		75-µm	+/- 3.0						
16		VMA in Percent <sup>[1]</sup>	-1.0						
17									
18		Test Result							
19									
20									
21									
22									
23									
24									

Check All

Check All

Check All

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

PASS

FAIL

PASS

Clear All

Revised 4-08-25

*Figure 13: Passing/Failing Mixture Properties.*

There are several buttons for worksheet functions found above each split sample and below the results of the analysis. The buttons perform the following functions:

<div style="border: 1px solid black; padding: 5px; background-color: #cccccc; display: inline-block;">Check All</div>	<ul style="list-style-type: none"> <li>Checks all properties as passing for the split sample below the button.</li> </ul>
<div style="border: 1px solid black; padding: 5px; background-color: #cccccc; display: inline-block;">Clear All</div>	<ul style="list-style-type: none"> <li>Clears all checkboxes (Resets the worksheet).</li> </ul>

## 9. Air Voids Pay Factor

This worksheet only appears when either “Combined Density and Volumetrics” or “Volumetric-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to review the test strip’s air voids results and the associated pay adjustments (Figure 14).

No information is to be entered into this worksheet.

Depending on the results of the t- and Xd Mean testing performed on the *Split Sample Comparison* worksheet, the QC or BTS test results will be used to calculate the air voids used to calculate the  $PWL_{VA}$  and Air Voids Pay Adjustment. Additionally, that party’s Gmm values will be used to calculate the Average Gmm (cell D11) used to calculate the Target Max Density (PCF) for the density portion of the test strip. The party whose results are used for the analysis is identified by the Gmm Source (cell D12).

Air Voids Pay Factor														
Date: 8/29/2024			Test Strip #: 1			Target <sub>va</sub> : 3.0								
Project ID:			Route/Road: USH 51			LSL <sub>va</sub> : 2.0								
Mix Type: 4-MT-98-28S			Layer: Upper			USL <sub>va</sub> : 4.3								
Air Voids														
Lot	Split Sample No.	Date	Gmm	Gmb	Air Voids	Standard Deviation	Mean	Number of Tests in Lot	PWL <sub>UL</sub>	PWL <sub>LL</sub>	PWL <sub>va</sub>	PF <sub>va</sub>	Lot Size (Ton)	Air Voids Pay Adjustment
TS-1	1	8/29/2024	2.443	2.367	3.1	0.107	3.0	3	100.00	100.00	100.00	104.00	844.88	\$ 1,098.34
	2		2.439	2.368	2.9									
	3		2.439	2.364	3.1									
Average Gmm:			2.440											
Gmm Source:			QC											
Acceptable Gmm & Gmb values carried in as determined from the Split Sample Comparison worksheet.														
Revised 4-08-25														

Figure 14: Air Voids Pay Adjustment Example.

## 10. Density Pay Factor

This worksheet only appears when either “Combined Density and Volumetrics” or “Density-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to review the test strip’s density results and the associated pay adjustments (Figure 15).

No information is to be entered into this worksheet.

Notes:

- For a Combined Volumetric and Density Test Strip, depending on the results of the split sample comparison testing, the QC or BTS test results will be used for the Average Gmm (cell D19) for the Target Max Density (PCF) of the cores and nuclear gauge readings.
- For a Density-Only Test Strip, the Daily Average Gmm for the Density-Only Test Strip Analysis (cell I1 in *Core Data*), will be used as the Average Gmm (cell D19) to calculate density.
- The Gmm source is identified in cell D20.
- The Department Representative will determine which party’s core density results will be used for acceptance, pay adjustment, and nuclear gauge correlation on the *Core Data* worksheet if verification testing is performed (otherwise the default is QC). The source of the data selected by the representative is identified in cell D21.

Density Pay Factor												PWL Default Unit Price	Contract Unit Price
Date:		8/29/2024		Test Strip #:		1		Lane Width(ft):		12.0			
Project ID:				Route/Road:		USH 51		Nominal Thickness(in):		2.00			
Mix Type:		4-MT-58-28S		Layer:		Upper		LSL(%):		93.0			
Zone	Core No.	Date	Core Data (%Gmm)	Standard Deviation	Mean	Number of Tests in Lot	PWL <sub>D</sub>	PF <sub>D</sub>	Lot Size (Ton)	Density Pay Adjustment			
1	UL-1	8/29/2024	95.1										
	UL-2		94.6										
	UL-3		96.4										
	UL-4		96.4										
	UL-5		94.0										
2	UL-6		93.1										
	UL-7		96.5										
	UL-8		96.4										
	UL-9		95.7										
	UL-10		94.2										
				1.22	95.2	10	97.76	103.11	850.01	\$ 858.02	460.2005 Incentive Density PWL HMA Pavement		
Average Gmm:		2.440											
Gmm Source:		QC											
Core Density Source:		QC											
Core data calculated from Contractor measured Gmm under Dept. supervision, and Gmm values determined acceptable in accordance with the paired t-test													
Final Length: 5,692.00 Feet													
Revised 4-08-25													

Figure 15: Density Pay Adjustment Example.

## 11. Test Strip Summary

This worksheet is used to display the acceptance results of the Test Strip as well as the Nuclear Density Gauge Correlation, if performed (Figure 16). The Nuclear Density Gauge Correlation will only appear when either “Combined Density and Volumetrics” or “Density-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet.

Each portion of the test strip is broken down into the various acceptance requirements:

- Split Sample Comparison
  - Gmm/Gmb t-test comparison.
  - Gmm within tolerance of JMF.
  - Test differences between parties are within tolerance.
- Density
  - PWL.
- Air Voids
  - PWL.
- AC % and Mix
  - Acceptable asphalt contents.
  - Acceptable Gradation and VMA.

Any agreed upon resolutions to any issues that occurred during the test strip should be entered in the Resolutions space at the bottom of this worksheet (range C46:H51). Examples of resolutions include, but are not limited to:

- Test Strip left in place but required the construction of another test strip prior to continuing to production.
- Test Strip removed and replaced.
- Contractor will make an adjustment to some process to bring some parameter back into acceptable limits.
- Contractor will reheat mixture during production to account for testing differences between parties.
- Etc.

This worksheet will decide based on the results of the test strip whether the material is acceptable (shown in ranges C9:H9 and C10:H10). It also determines the following outcomes of the test strip:

- Approved, proceed with production.
- Approved; However, consult Regional PWL Rep. & BTS prior to proceeding with production.
- Not approved. Consult Regional PWL Rep. & BTS.

	A	B	C	D	E	F	G	H	I	J	K	L
1	<b>Test Strip Summary</b>											
2	Contract: _____				Test Strip #: 1				Paving Width(ft): 16.0			
3	Job No./Project ID: _____				Route/Road: STH 96				Lane Width(ft): 11.0			
4	WisDOT Mix No.: 0-250-0152-2024				Test Strip Layer: Upper				Nominal Thickness(in): 2.00			
5	Mix Type: 4-MT-58-28S				Underlying Layer: Existing HMA				Contract Unit Price: \$73.40			
6	File Name: _STH 96_4-MT-58-28S_Upper_PWL-TS-1-C				Test Strip Type: Combined Density and Volumetrics Test Strip							
7												
8	<b>Overall Test Strip Approval and Material Acceptance</b>											
9	Test Strip	Approved; However, consult Regional PWL Rep. & BTS prior to proceeding with production.										
10	Material	Conforming, Test Strip Material May Remain in Place.										
11	<b>Split Sample Comparison</b>											
12	Gmm Split Sample t-test Results						Datasets Compare.					
13	Gmm Test Differences Within Tolerance?						Test differences within testing tolerance.					
14	Gmm Within Tolerance to JMF?						Gmms are within JMF Acceptance Limit.					
15	Gmb Split Sample t-test Results						Datasets Compare.					
16	Gmb Test Differences Within Tolerance?						Test differences within testing tolerance.					
17	Pass											
18	<b>Density</b>											
19	Density Test Strip Tonnage						497.5					
20	PWL						100.00					
21	Pay Factor						104.00					
22	Density Net Pay Adjustment						\$646.69					
23	Non-Random Gmm Test Result (Density Only Test Strip)						Not Applicable.					
24	Pass											
25	<b>Air Voids</b>											
26	Air Voids Test Strip Tonnage						769.66					
27	PWL						100.00					
28	Pay Factor						104.00					
29	Air Voids Net Pay Adjustment						\$1,000.56					
30	Pass											
31	<b>AC % and Mix Acceptance Results</b>											
32	AC %						Acceptable, but consult BTS for QC-QV differences more than 0.2%.					
33	Mix Acceptance						Pass					
34												
35	<b>Nuclear Density Gauge Correlation (Info from QC/QV Density, Correlation, and Gauge-Core Variability Worksheets)</b>											
36	Gauge ID	NUCDENSITYTEC	Gauge Serial #	Core Spread (%)	Gauge Spread (%)	Gauge Comp. Avg.	Correlation R <sup>2</sup>	Gauge Recommendation	Gauge Offset			
37	QC-1		8969		2.5	0.7	2.28%	Secondary QC	0.8			
38	QC-2		8058	1.4	1.8	0.6	2.61%	Primary QC	0.4			
39	QV-1		30869		2.1	0.4	66.06%	Primary QV	0.3			
40	QV-2		30961		1.7	0.4	30.46%	Secondary QV	0.6			
41	Resolutions:											
42												
43												
44												
45												
46												
47												
48												
49												
50												
51												
52												
53												

Save with Suggested File Name and send a copy of the completed Test Strip Excel file to the Regional PWL Rep. and BTS (\_\_\_\_\_).

Save As with Suggested File Name and Email to BTS for Review

Export All Worksheets as PDF

Export Test Strip Summary as PDF



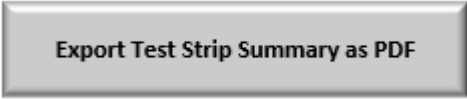
460.2005 Incentive Density PWL HMA Pavement

460.2010 Incentive Air Voids HMA Pavement

Revised 4.08.25

Figure 16: Test Strip Summary Example.

There are several buttons for worksheet functions found on the righthand side of the interface. The buttons perform the following functions:

	<ul style="list-style-type: none"><li>• Saves the spreadsheet as a new Excel file (without overwriting old versions) with the suggested file name, including the date and time that the spreadsheet was saved.</li><li>• Creates a new email to send the test strip file to BTS. (Note: This function only works with Outlook.)</li><li>• You will be able to edit the email before it sends.</li></ul>
	<ul style="list-style-type: none"><li>• Exports the entire spreadsheet and its worksheets as a PDF.</li></ul>
	<ul style="list-style-type: none"><li>• Exports only the Test Strip Summary worksheet.</li></ul>



This worksheet only appears when either “Combined Density and Volumetrics” or “Density-Only” is selected as the Test Strip Type on the *Project Info & Instruction* worksheet. This worksheet is used to review the Location Comparison Averages and the Gauge Comparison for nuclear gauge correlation portion of the test strip (Figure 17).

The tables on the left half of the worksheet reflect the comparisons which may or may not have suspect cores removed from the analysis. The tables on the right half of the worksheet reflect the comparisons using all of the original data with no removed suspect cores.

- The Location Comparison table is used to determine whether a core is deemed suspect. A core is deemed suspect when the Average of the Adjusted Differences (cells G12-G21) from all the gauges is either greater than or equal to 1.0 or less than or equal to -1.0 for a specific core. Suspect cores will be flagged in the table automatically with a red background Location Comparison Average and “Suspect Core” appearing in the third column (Figure 18). Cores deemed suspect may only be removed from the analysis by the Department Representative. Removing cores can be done in the *Core Data* worksheet. Refer to section 6 Core Data for additional information on removing cores (Figure 19).
- The Gauge Comparison table is used to determine whether a nuclear gauge is deemed suspect. A nuclear gauge is deemed suspect when the Average Absolute Adjusted Difference (Cells B36, C36, D36, and E36) for a particular gauge is greater than or equal to 1.0%. Suspect gauges will be flagged in the table automatically with a red background showing on the testing party, gauge ID, and Gauge Comparison Average (Figure 18). Gauges deemed suspect should be removed from the project and further diagnostics should be performed in coordination with the WisDOT Radiation Safety Officer.

Figure 17: Gauge-Core Variability Tables

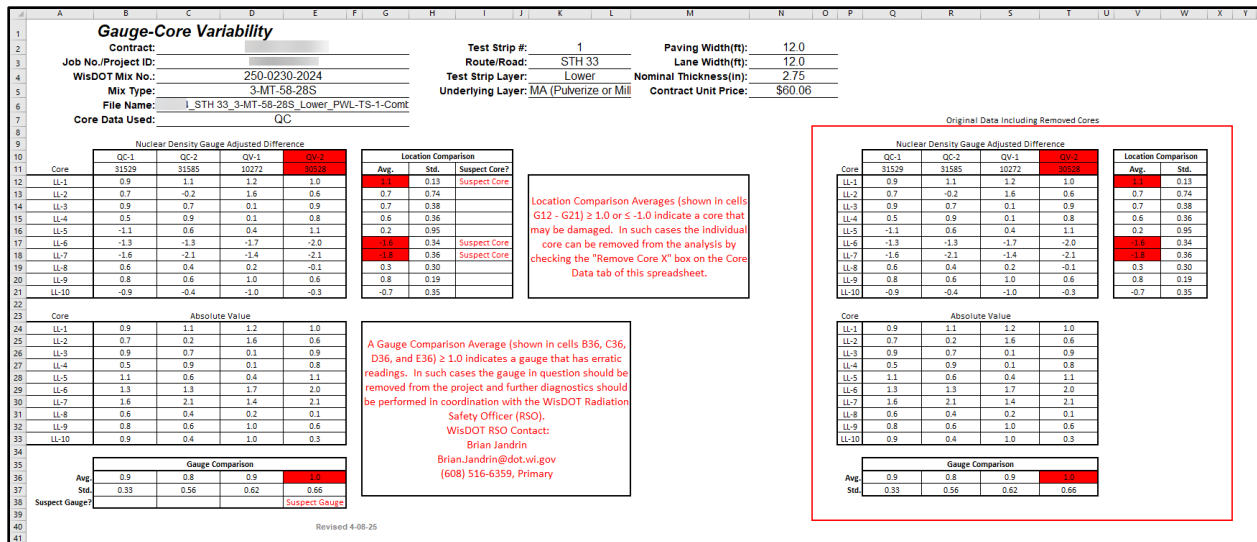


Figure 18: Suspect Cores/Gauges Example.

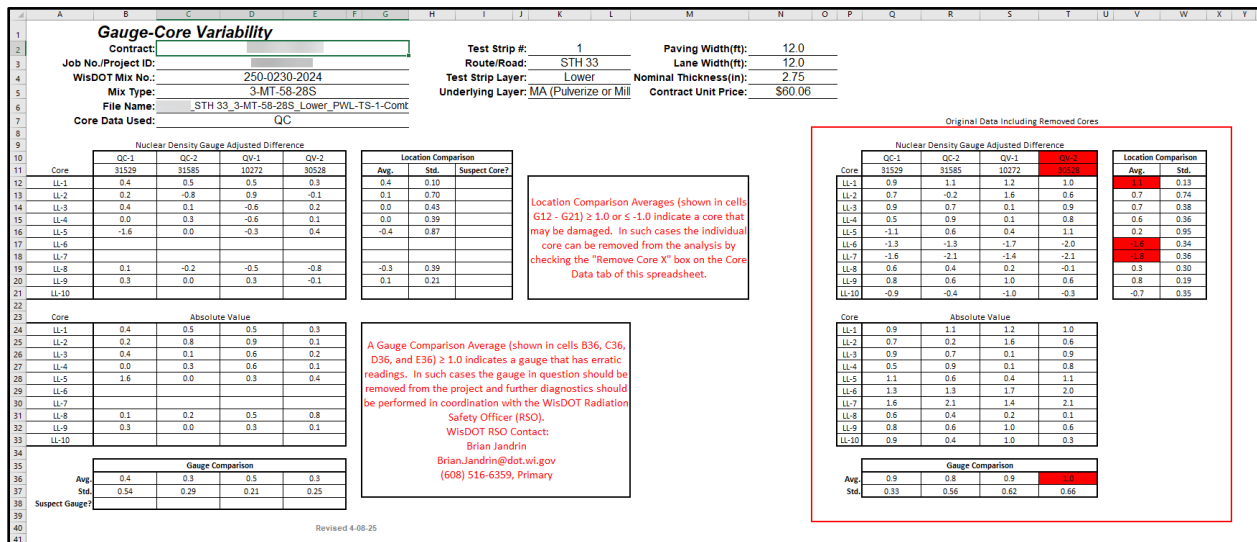


Figure 19: Removed Suspect Cores Example.

### 13. QC-X / QV-X Density Worksheets

These worksheets only appears when either “Combined Density and Volumetrics” or “Density-Only” is selected as the Test Strip Type on the *Project Info & Instructions* worksheet. These are the field density worksheets that should be used for the test strip by the density technicians. These worksheets can be saved as PDFs and printed from the *Project Info & Instructions* worksheet if desired. These worksheets must be filled out to complete the nuclear gauge correlation.

The Department Representative will enter the following information into the worksheet received from the density technicians:

- Density and Moisture Standards
- Gauge Serial Number
- QC/QV Technician Name
- M Counts / D Counts for Reading 1
- Wet Density 1 (PCF)
- M Counts / D Counts for Reading 2
- Wet Density 2 (PCF)
- M Counts / D Counts for Reading 3 (if required)
- Wet Density 3 (PCF) (if required)
- Test Remarks

PWL DENSITY DATA FORM (LANE FOOT)										Revised 4-08-25			
Nuclear HMA Density QC/QV Testing Records										TEST STRIP #1	QC-1		
Station Decreasing: FALSE										LAYER:	Lower		
Project ID:		Road Name:		Contractor:		Gauge Serial #:		Density Standard:		4012			
Project Leader:		County:		NUCDENSITYTEC:		WisDOT Mix #:		Moisture Standard:		997			
<b>TEST STRIP - Field Density Worksheet</b> • Offsets are predetermined according to the test strip layout in WisDOT's Manual of Test Procedures WTP H-002. • Gauge offset is set to ZERO since offsets will be determined from the test strip. • The Target Max Gmm is the average from the 3 split samples, except for a density only test strip, then it is the daily average Gmm from production. • Calculated per WisDOT's Manual of Test Procedures WTM T355.						QV		Mix Type:		3-MT-58-28S			
						Start:		End:		Target Gmm:		2.573	
						Length (ft):		3,653		Target Max Density (PCF):		160.1	
						Lane Width (ft):		12.0		Required Density %:		91.0	
						Nominal Thickness(in):		2.75		Date Placed:		8/6/2024	
						Gauge Offset:		ZERO		Date Tested:		8/6/2024	
Gauge/Core Spacing (ft):		50		Reading 1		Reading 2 (rotate 180)		Reading 3 (if needed, original orientation)		Final Density			
Lot / Sub Lot ID	Station	Offset from CL	M Count / D Count	Wet Density 1	% Max Density 1	M Count / D Count	Wet Density 2	% Max Density 2	M Count / D Count	Wet Density 3	% Max Density 3	Average PCF	% Max Density
LL-1	09+94	1.5	203/1976	146.2	91.3%	201/1968	146.7	91.6%				146.5	91.5%
LL-2	10+44	3.5	189/1929	148.8	92.9%	206/1918	149.4	93.3%				149.1	93.1%
LL-3	10+94	6.0	207/1897	150.5	94.0%	197/1912	149.7	93.5%				150.1	93.8%
LL-4	11+44	8.5	187/1892	150.8	94.2%	195/1909	149.9	93.6%				150.4	93.9%
LL-5	11+94	10.5	192/1910	149.8	93.6%	192/1975	146.3	91.4%	188/1912	149.7	93.5%	149.8	93.6%
LL-6	30+75	1.5	193/1915	149.5	93.4%	201/1927	148.9	93.0%				149.2	93.2%
LL-7	31+25	3.5	206/1899	150.4	93.9%	199/1889	151.0	94.3%				150.7	94.1%
LL-8	31+75	6.0	196/1905	150.1	93.8%	200/1913	149.7	93.5%				149.9	93.6%
LL-9	32+25	8.5	204/1958	147.2	91.9%	204/1911	149.8	93.6%	200/1950	147.6	92.2%	147.4	92.1%
LL-10	32+75	10.5	193/1937	148.3	92.6%	201/1922	149.2	93.2%				148.8	92.9%
Target Max Density = Gmm x 0.224													
Test Remarks													

Figure 20: QC-X / QV-X Field Density Worksheet Example.

## 14. QC-X / QV-X Correlation

These worksheets only appears when either “Combined Density and Volumetrics” or “Density-Only” is selected as the Test Strip Type on the *Project Info & Instructions* worksheet. These worksheets are used to review the correlation of each nuclear gauge.

No information is to be entered into this worksheet.

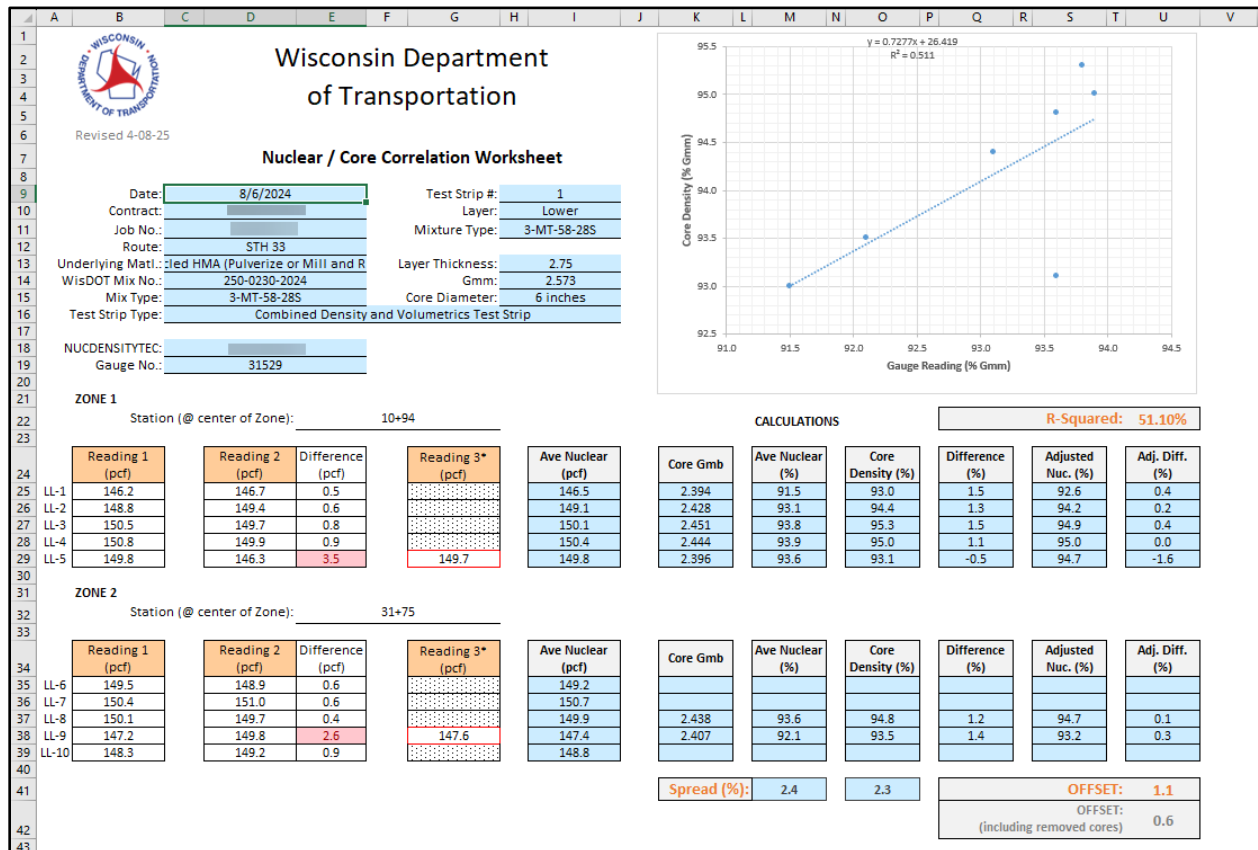


Figure 21: QC-X / QV-X Correlation Example.

Notes:

- Cores that were removed from the analysis on the *Core Data* worksheet will not appear in the tables nor will they affect the correlation.

## **15. Appendix**

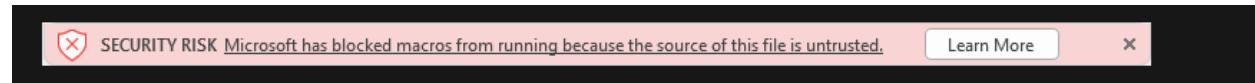
### **15.1 t-Testing**

The spreadsheet adheres to the specifications for determining whether QC and QV data compare by conducting paired t-tests on *Split Sample Comparison* data.

The t-tests during the test strip use an alpha value of 0.01. The alpha value determines the likelihood of a “false flag” or a failed comparison due to factors other than an actual difference in the population (or material source). Using an alpha value of 0.01, the t-test will fail 1 in 10 times (or about 10% of the time) when the two datasets are actually from the same population. The t-tests “pass” or compare when the p-value from either test is greater than alpha.

## 15.2 Enabling Macros (Red Banner)

As of February 23, 2023, Microsoft has blocked macros by default from spreadsheets downloaded from the internet (i.e.: Pantry) to provide additional protection from malicious macros. When this occurs, you will see an error like this at the top of the spreadsheet:

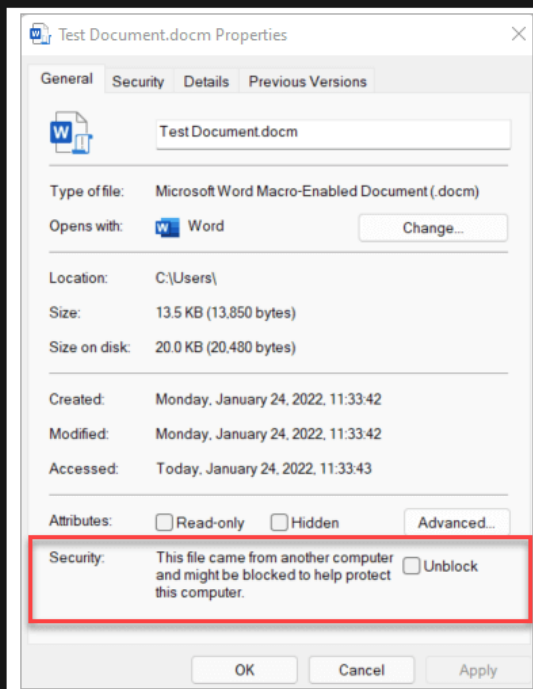


When this error is presented, you will be unable to enable macros using old methods where you could simply click the button in the banner to enable macros. Additional steps are required to enable the macros. Perform the following steps to enable macros:

### Guidance on allowing VBA macros to run in files you trust

#### Remove Mark of the Web from a file

For an individual file, such as a file downloaded from an internet location or an email attachment the user has saved to their local device, the simplest way to unblock macros is to remove Mark of the Web. To remove, right-click on the file, choose **Properties**, and then select the **Unblock** checkbox on the **General** tab.



Additional information about this change can be found on Microsoft's website at:  
<https://learn.microsoft.com/en-us/deployoffice/security/internet-macros-blocked>