STATE OF WISCONSIN

MANUAL OF TEST PROCEDURES

2025 Edition

Effective with January 2025 letting

Text in red color found within this edition indicate substantive changes made to the previously published edition of the Manual of Test Procedures.

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Wisconsin Test Modified	***Summary of Revision***
WTM R35	Updated RAS Gsb note.
WTM R47	Clarified splitting guidance.
WTM R67	Added notes for coring HMA.
WTM R97	Clarified sampling guidance.
WTM T166	Updated notes and PWL guidance.
WTM T209	Clarified reporting requirements.
WTM T283	Removed requirement for distilled water.
WTM T355	Significant edits. Density test strip layout information moved to WTP H-002.
WTP H-002	Significant edits. Addition of density test strip layout requirements that moved from WTM T355.
WTM M320	Corrected combined state binder group label.
WTM M332	Corrected combined state binder group label.
WTM R66	Clarified sample container requirements.
WTM T27	Updated to 2023 version.
WTP M-001	Added beam guard coating thickness quality verification Wisconsin test procedure.
WTP A-001	Moved field procedure from CMM 860.8
WTP A-002	Moved field procedure from CMM 860.9
WTP A-003	Moved field procedure from CMM 860.13
WTP S-001	Moved field procedure from CMM 855.1
WTM T309	Added procedure for Temperature of Freshly Mixed Portland cement Concrete.
WTM T119	Updated to 2023 version.
WTM T113	Updated to 2022 version.
WTM T22	Added strength evaluation.
WTM T24	Clarified report requirements.
WTM T97	Added timeframe for testing, strength evaluation.
WTM T152	Added calibration of pressure air meter to annex D.
WTP C-001	Added strength test of cubes.
WTO C-003	Added language clarifying process for reporting requirements for sidewalks and driveways.

Wisconsin Test Modified (WTM) is a WisDOT modification to the AASHTO or ASTM Test Procedures as specified herein.

Wisconsin Test Procedure (WTP) is a WisDOT testing procedure that does not have a corresponding AASHTO or ASTM method.

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HOT MIX ASPHALT (HMA)

ASPHALT BINDER

PORTLAND CEMENT CONCRETE (PCC)

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How to Use this Manual of Test Procedures

What to do when WisDOT does not modify an AASHTO or ASTM procedure:

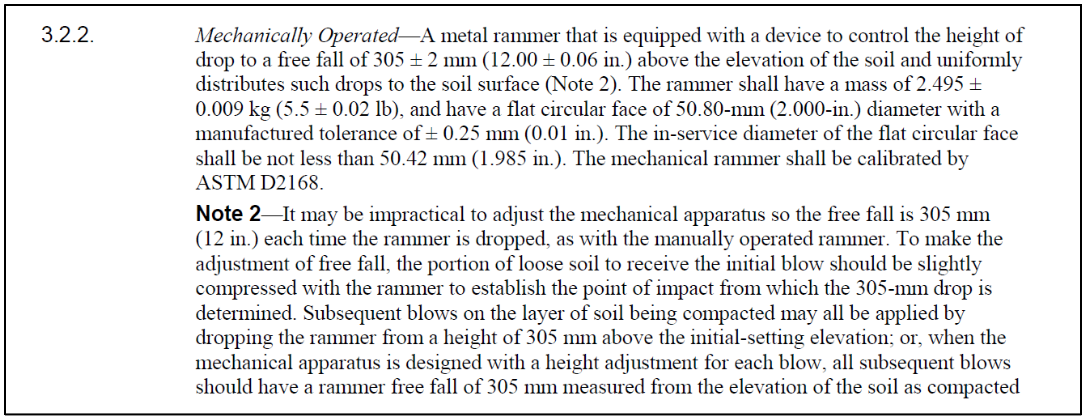
There may be instances where WisDOT requires an ASTM and/or AASHTO test method that is not modified per this manual. In those instances, the technician is required to follow the original AASHTO and/or ASTM procedure, using any relevant applicable referenced WTM or WTP procedures. Always check for a modified procedure. Those take precedence.

> For Example:
>
> AASHTO T164 – Quantitative Extraction of Asphalt Binder from Hot Mix Asphalt (HMA) is required by WisDOT but is not modified by this Manual. This procedure references AASHTO R97, T30, T84, and T329. The technician shall follow the AASHTO T164 testing procedure, replacing any AASHTO references with applicable WTMs. In this example, AASHTO R 97 will be replaced with WTM R97, AASHTO T30 will be replaced with WTM T30, AASHTO T84 will be replaced with WTM T84 and AASHTO T329 will be replaced with WTM T329.

When the text is “replaced”:

Throughout this manual there are instances where sections of the ASTM or AASHTO are “replaced” with modified text. The limit of the replaced text is defined by the indent. Whatever text, including notes, that falls within the same indent will be replaced with the modified text. If a note or table fall outside the indent, it is not considered modified.

> For Example:
>
> “Note 2” falls within the indent. If Section 3.2.2 is replaced by the Manual of Test Procedures, then “Note 2” is also replaced by the modified text. Be aware, the next chronological Note will not be renumbered when a Note is deleted by modified text.



3.2.2. *Mechanically Operated*—A metal rammer that is equipped with a device to control the height of drop to a free fall of 305 ± 2 mm (12.00 ± 0.06 in.) above the elevation of the soil and uniformly distributes such drops to the soil surface (Note 2). The rammer shall have a mass of 2.495 ± 0.009 kg (5.5 ± 0.02 lb), and have a flat circular face of 50.80-mm (2.000-in.) diameter with a manufactured tolerance of ± 0.25 mm (0.01 in.). The in-service diameter of the flat circular face shall be not less than 50.42 mm (1.985 in.). The mechanical rammer shall be calibrated by ASTM D2168.

Note 2—It may be impractical to adjust the mechanical apparatus so the free fall is 305 mm (12 in.) each time the rammer is dropped, as with the manually operated rammer. To make the adjustment of free fall, the portion of loose soil to receive the initial blow should be slightly compressed with the rammer to establish the point of impact from which the 305-mm drop is determined. Subsequent blows on the layer of soil being compacted may all be applied by dropping the rammer from a height of 305 mm above the initial-setting elevation; or, when the mechanical apparatus is designed with a height adjustment for each blow, all subsequent blows should have a rammer free fall of 305 mm measured from the elevation of the soil as compacted

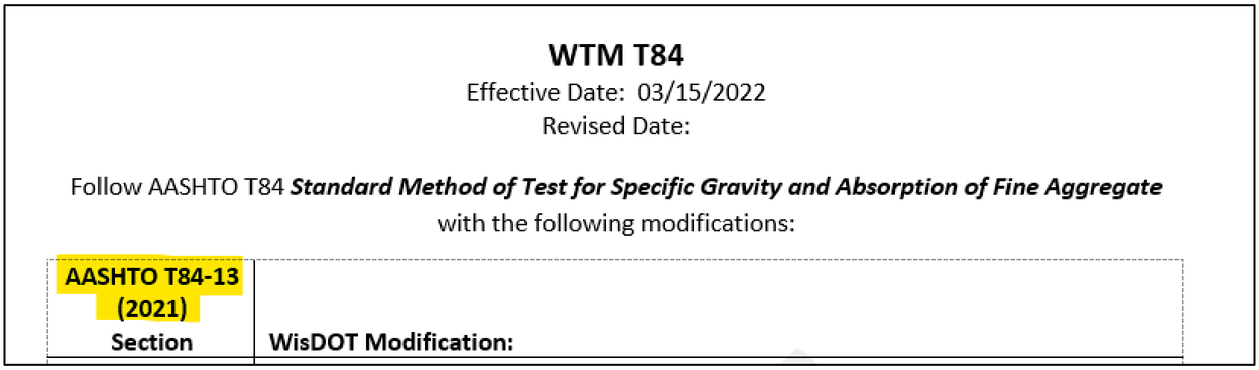
When Modified Procedures are referenced:

In each modified test method, there is a section where other WTM procedures are referenced to supersede the original AASHTO or ASTM procedure (usually Section 2 in AASHTO). If there are other sections within the AASHTO or ASTM procedure that are not modified by this manual, but also reference the original AASHTO or ASTM procedure, it is inferred that the WTM should be used. In all cases, a WTM procedure supersedes the original AASHTO or ASTM procedure.

Which AASHTO or ASTM version to use:

Every year AASHTO and ASTM procedures may be updated. This manual will clearly list which version of each AASHTO and ASTM procedure is to be used and modified. AASHTO and ASTM versions may be updated annually, however in all instances use the version referenced in the MOTP even if a newer version exists.

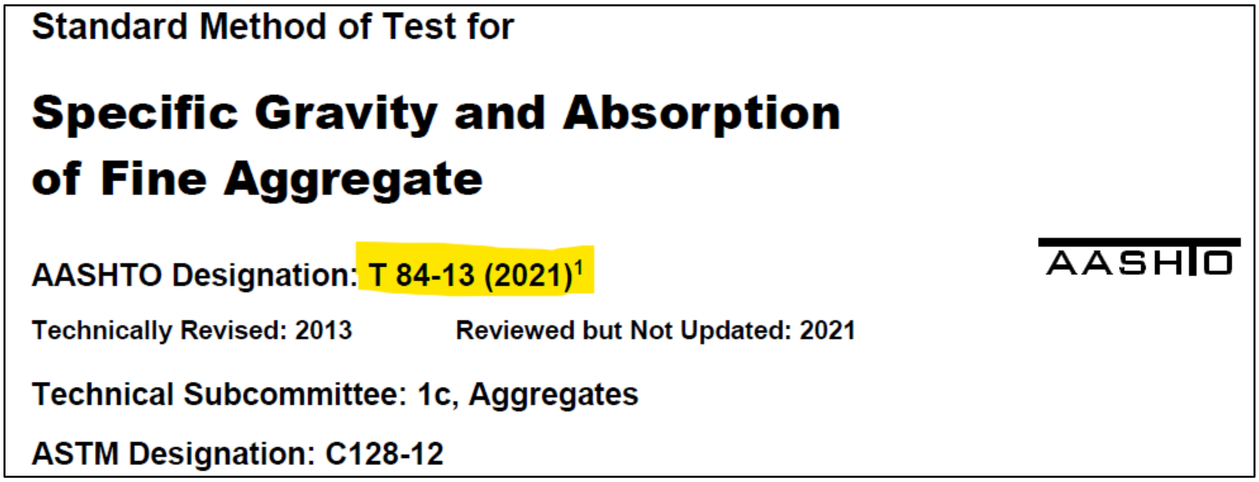
For Example:
WTM T84 references AASHTO T84-13 (2021), as highlighted in the first picture below. This means that AASHTO T 84 was "technically revised" in 2013, and it was "reviewed but not updated" in 2021, as seen in the second picture below. Technicians should always ensure they are using the correct version of the referenced AASHTO or ASTM procedure.



WTM T84
Effective Date: 03/15/2022
Revised Date:

Follow AASHTO T84 ***Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate*** with the following modifications:

AASHTO T84-13 (2021) Section	**WisDOT Modification:**



Standard Method of Test for

Specific Gravity and Absorption of Fine Aggregate

AASHTO Designation: T 84-13 (2021)[1]

Technically Revised: 2013 Reviewed but Not Updated: 2021

Technical Subcommittee: 1c, Aggregates

ASTM Designation: C128-12

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WisDOT Preferred Methods:

There are some AASHTO and ASTM procedures that allow for multiple methods to perform the test. In some cases, WisDOT will only allow one of the optional methods. If the modified procedure removes a method, it is inferred that any subsequent mention of that method is also disallowed without the need for a specific call out in the Manual of Test Procedures.

> For Example:
>
> WTM T304 removes Method B and Method C in Section 1, only allowing Method A for WisDOT. In Section 9, the AASHTO procedure describes Method B and Method C in detail. Since the MOTP previously removed Method B and Method C, there is no need to continue to remove all mention of Method B and Method C throughout the WTM – it is inferred.

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Definitions

Asphalt Release Agent	A non-stick product that prevents the asphalt mixture from sticking to the apparatus and does not contain any solvents or petroleum-based products that could affect asphalt binder properties. WisDOT approved solvents are those considered “Non-stick Cooking Spray”.
Field Sample	A volume of material to represent the product being sampled. A field sample is a composite of all increments sampled.
Nominal Maximum Particle Size	The largest sieve that retains some of the aggregate particles, but generally not more than 10% by weight.
P4	Material passing the #4 (4.75mm) sieve
R4	Material retained on the #4 (4.75mm) sieve
Test Sample	A reduced field sample, to represent the whole. There can be more than one test sample per field sample when replicates are required.
Wetting Agent	Any dispersing agent, such as dishwashing detergent, that will promote separation of the fine materials.

WTM D3665

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow ASTM D3665 ***Standard Practice for Random Sampling of Construction Materials*** with the following modifications**:**

ASTM D3665-12 (2017) Section	**WisDOT Modification:**
2.1	*Throughout the ASTM D3665 and this modification, replace any reference to the ASTM Standards C172, D75, D140 and D979 with the following WisDOT Modified versions:* WTM R90 – Sampling of Aggregate WTM R97 – Sampling HMA Mixtures WTM R60 – Sampling Freshly Mixed Concrete
Section 6	*Replace Section 6 and all subsequent subsections, tables, and figures with the following:* Random numbers can be determined by any of the following methods: 1. Following Section 5 of ASTM D3665. 2. Using a random number generator on any calculator or phone. 3. Using an Excel spreadsheet random number generator.

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WTM R76

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO R76 ***Standard Practice for Reducing Samples of Aggregate to Testing Size*** with the following modifications**:**

<table>
<tr><th>AASHTO R76-23 (2020) Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO R90 and T84 references with the following WisDOT Modified versions:</i>
WTM R90 – Sampling of Aggregate
WTM T84 – Fine Aggregate Specific Gravity</td></tr>
<tr><td>Section 5.1</td><td><i>Replace Section 5.1 with the following:</i>
The sample should be reduced to the size needed for a specific test by using either a riffle splitter (Method A), quartering method (Method B) or miniature stockpile method (Method C) for damp fine aggregate only. The riffle splitter should not be used for fine aggregates that are wetter than saturated surface dry (SSD). Fine aggregates that are in a free moisture condition (damp) should be split using the quartering method or miniature stockpile method.</td></tr>
<tr><td>Section 7.1</td><td><i>Add the following table to Section 7.1: Splitter Chute Opening Requirements</i>
<table>
<tr><th>Type of Aggregate</th><th>Chute Width</th></tr>
<tr><td>Coarse Aggregate and mixed aggregate</td><td>Approximately 50% larger than the largest particle in the sample. No 2 concrete stone or similar size aggregates may be split using a 2 in. chute opening splitter if free flow of the aggregate is maintained.</td></tr>
<tr><td>Dry fine aggregate that entire sample will pass the 3/8 in. sieve</td><td>Minimum width at least 50% larger than the largest particle in the sample. Maximum width must be ¾ in.</td></tr>
</table>
</td></tr>
</table>

WTM R90

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO R90 ***Standard Practice for Sampling Aggregate Products*** with the following modifications:

<table>
<tr><th>AASHTO R90-18 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO T11 and T27 references with the following WisDOT Modified versions:</i>
WTM T11 – Finer than No.200
WTM T27 – Sieve Analysis</td></tr>
<tr><td>2.2</td><td><i>Revise Section 2.2 to replace the reference to ASTM D75/D75M with the WTM R90 reference.</i></td></tr>
<tr><td>3.3</td><td><i>Revise Section 3.3 to replace the reference to ASTM D75 with the WisDOT Modified R90 reference.</i></td></tr>
<tr><td>Table 1</td><td><i>Replace Table 1 with the following:</i>
<table>
<tr><th rowspan="2">Nominal Maximum Aggregate Size</th><th colspan="2">Minimum Weight of Field Samples*</th></tr>
<tr><th>kg</th><th>lb.</th></tr>
<tr><td colspan="3">Fine Aggregate</td></tr>
<tr><td>#10 (2.0mm)</td><td>5</td><td>10</td></tr>
<tr><td>#4 (4.75mm)</td><td>5</td><td>10</td></tr>
<tr><td colspan="3">Coarse Aggregate</td></tr>
<tr><td>⅜ in. (9.5mm)</td><td>5</td><td>10</td></tr>
<tr><td>½ in. (12.5mm)</td><td>10</td><td>25</td></tr>
<tr><td>¾ in. (19.0mm)</td><td>15</td><td>35</td></tr>
<tr><td>1 in. (25.0mm)</td><td>25</td><td>55</td></tr>
<tr><td>1 ¼ in. (31.75mm)</td><td>25</td><td>55</td></tr>
<tr><td>1 ½ in. (37.5mm)</td><td>30</td><td>70</td></tr>
<tr><td>2 in. (50mm)</td><td>40</td><td>90</td></tr>
<tr><td>2 ½ in. (62.5mm)</td><td>45</td><td>100</td></tr>
<tr><td>Larger than 2 ½ in. (62.5mm)</td><td>115</td><td>250</td></tr>
</table>
*When split samples are taken, the field sample size shown above is doubled.</td></tr>
<tr><td>Note 2</td><td><i>Delete Note 2</i></td></tr>
</table>

5.3	*Add the following to Section 5.3 –* ***Sampling from Conveyor Belt Using a Sample Template:*** After normal flow has been established, stop the belt.
5.3.2	*Add the following to Section 5.3.2:* If the angle of the conveyor belt is such that aggregate particles roll, place templates, with forms fitting the configuration of the conveyor belt, through the increments at their ends before collecting the material.
5.3.3	*Add the following to Section 5.3.3:* If needed, use a brush to collect all the fines from the belt.
5.3.4	*Replace Section 5.3.4 with the following:* Obtain at least three approximately equal increments from the unit being sampled and combine them to form a field sample of the required size.
5.4	*Add the following to Section 5.4 –* ***Sampling from Conveyor Belt Discharge:*** Randomly select units to be sampled from production after normal flow has been established. Obtain at least three approximately equal increments from the unit being sampled and combine to form a field sample. Take each increment from the entire cross-section of the material as it is being discharged.
5.4.2	*Delete Section 5.4.2*
5.5	*Add the following to Section 5.5 –* ***Sampling from Transport Units:*** Discharge the entire load on the ground from a moving truck to form an elongated pile.
5.5.1	*Replace Section 5.5.1 with the following:* Level the top and obtain at least three increments from distributed points.
5.7	*Add the following to Section 5.7 –* ***Sampling from Roadway – In Place:*** Obtain at least three approximately equal increments, selected at random, from the unit being sampled. A 100-foot unit should be selected to represent the area to be evaluated. If the above units cannot be selected, then another length may be selected and so noted in the project records.
5.7.2	*Add the following to Section 5.7.2:* Take increments for the depth of the material under consideration, being careful not to contaminate the sample with any underlying material. A square nose shovel must be used to obtain each sample increment. Care should be taken not to cause degradation of the aggregate during the sampling process. Care should also be taken to keep the sides as vertical as possible during the excavation.

5.8.1	*Add the following to Section 5.8.1: **Sampling from a Stockpile using a Loader:*** The working face is the face of the pile from which the aggregate is being removed.
5.8.1.1	*Add the following to Section 5.8.1.1:* Obtain each quarter point sample by cutting deep into the face of the pile with an end loader or other similar power equipment.
5.8.1.3	*Add the following to Section 5.8.1.3:* Dump each quarter point sample in a separate pile, level the pile and take at least three shovels full to form one increment.
5.8.1.4	*Add the following to Section 5.8.1.4:* Obtain increment samples from each quarter point of the working face of the stockpile.
5.8.1.6	*Add the following to Section 5.8.1.6:* The total sample will consist of three increments, one increment from each quarter point sample.
5.8.2.1	*Add the following to Section 5.8.2.1: **Sampling from a Horizontal Surface on the Stockpile Face:*** Increments must be obtained by holding a protective barrier above the sampling location to prevent aggregate slide and discarding 10 - 12 inches of surface aggregate.
5.8.2.4	*Replace Section 5.8.2.4 with the following:* Obtain increments with a square nosed shovel from quarter points of the pile perimeter at both 1/3 and 2/3 levels of slope length from bottom to top. Total sample = 8 increments.
5.10	*Add Section 5.10 with the following: **Sampling from a Truck – Discharge:*** With the box elevated, open the gate about 6 - 10 inches. With a suitable sample box: Obtain the first increment from the discharge near one side of the gate and representing first part of discharge. Obtain the second increment from the discharge near the middle of the gate and representing approximately the middle of the total discharge. Obtain the third increment from the discharge near the other side of the gate and representing the last part of the total load.
5.11	*Add Section 5.11 with the following: **Sampling when using a Clam Shovel:***

	When aggregate is transferred from a stockpile to the proportioning bins with a clam shovel or bucket, dump a selected clam full on the ground, level the top and obtain at least three increments from distributed points.

WTM T11

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T11 ***Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregate by Washing*** with the following modifications:

<table>
<tr><th>AASHTO T11-20 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO R76, R90 and T27 references with the following WisDOT Modified versions:</i>
WTM R76 – Reducing Samples of Aggregate
WTM R90 – Sampling of Aggregate
WTM T27 – Sieve Analysis</td></tr>
<tr><td>5.4</td><td><i>Replace Section 5.4 with the following:</i>
<i>Drying Equipment</i> – An oven, hot plate, stove, or other device for heating and drying the sample uniformly and as rapidly as possible without damaging the aggregate is acceptable.</td></tr>
<tr><td>6.2</td><td><i>Replace the table in Section 6.2 with the following:</i>
<table>
<tr><th>Nominal Maximum Aggregate Size</th><th>Minimum Weight of Sample, g</th><th>Minimum Weight of Sample, lb.</th></tr>
<tr><td>No. 4 (4.75mm) or smaller</td><td>300</td><td>0.66</td></tr>
<tr><td>½ in. to ⅜ in (9.5mm – 12.5mm)</td><td>1,000</td><td>2.2</td></tr>
<tr><td>¾ in. – 1 in. (19.0mm – 25.0 mm)</td><td>2,500</td><td>5.5</td></tr>
<tr><td>1 ½ in. or over (≥ 37.5mm)</td><td>5,000</td><td>11</td></tr>
</table>
For samples weighing 11 lb. (5,000g) or more, it is recommended that sieves or coarse aggregate fractions be mounted in 12-inch or larger frames or the sieving may be done in increments using the standard 8-inch diameter sieves.</td></tr>
<tr><td>7.1</td><td><i>Replace Section 7.1 with the following:</i>
Either Procedure A (Washing with Plain Water) or Procedure B (Washing Using a Wetting Agent) are acceptable.</td></tr>
<tr><td>8.1</td><td><i>Replace Section 8.1 with the following:</i>
Dry the test sample to a constant mass using a 110 ± 5°C (230 ± 9°F) oven, measuring mass at 15 minute intervals until there is less than 0.1% mass loss.</td></tr>
</table>

	Determine the mass to the nearest 0.1 percent of the mass of the test sample. Samples shall be stirred frequently in order to prevent popping or breaking of aggregate. The drying pan shall be large enough to permit manipulation during drying of the aggregate without loss by spilling. NOTE: If reprocessed materials contains asphalt materials, only use an oven and do not stir.
8.3	*Add the following to Section 8.3:* When clay lumps or clay coatings on the aggregate particles are noted, the sample must be allowed to soak at least 10 minutes before agitating and decanting. For dirty aggregates, it may be necessary to wait 10 to 15 seconds before decanting the wash water in order to avoid blocking the openings of the 0.075mm (#200) sieve. When the 0.075mm (#200) sieve becomes blocked, it may be reopened by back-washing the material retained on the 0.075mm (#200) sieve into the drying pan. Agitation should be sufficiently vigorous to completely separate all of the passing the 0.075mm (#200) material from other particles and to bring all the passing the 0.075mm (#200) fraction into suspension in order that it will be removed by decantation of the wash water. Twisting of the pail handle will usually not result in vigorous enough action.
NOTE 3	*Add the following to Note 3:* When using Mechanical Washing equipment, take care to ensure aggregates do not degrade during the washing process.
NOTE 4	*Add the following to Note 4:* Take care to ensure aggregates do not degrade during the washing process.
9.2	*Add the following to Section 9.2:* When clay balls or clay coatings on the aggregate particles are noted, the sample must be allowed to soak at least 10 minutes before agitating and decanting. For dirty aggregates, it may be necessary to wait 10 to 15 seconds before decanting the wash water to avoid blocking the openings of the 0.075mm (#200) sieve. When the 0.075mm (#200) sieve becomes blocked, it may be reopened by back-washing the material retained on the 0.075mm (#200) sieve into the drying pan. Agitation should be sufficiently vigorous to completely separate all of the passing the 0.075mm (#200) material from other particles and to bring all the passing the 0.075mm (#200) fraction into suspension in order that it will be removed by decantation of the wash water. Twisting of the pail handle will usually not result in vigorous enough action.
11.1	*Replace section 11.1 with the following:* Note that the final gradation results are calculated to the nearest 0.1% for all sieves. However, when results are reported, percentages are rounded off to the

	nearest whole percent except for the percent passing the 0.075mm (#200) sieve, which is reported to the nearest 0.1% and administered in accordance with the specification requirements.

WTM T27

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T27 ***Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates*** with the following modifications:

<table>
<tr><th>AASHTO T27-24 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><p>Replace the AASHTO R76, R90 and T11 references with the following WisDOT Modified versions:</p><p>WTM R76 – Reducing Samples of Aggregate
WTM R90 – Sampling of Aggregates
WTM T11 – Finer than No. 200</p></td></tr>
<tr><td>5.4</td><td><p>Replace Section 5.4 with the following:</p><p>Drying Equipment – An oven, hot plate, stove, or other device for heating and drying the sample uniformly and as rapidly as possible without damaging the aggregate is acceptable. Samples should be stirred frequently in order to prevent popping or breaking of aggregate. The drying pan should be large enough to permit manipulation during drying of the aggregate without loss by spilling. The drying pan should be kept clean.</p></td></tr>
<tr><td>6.1</td><td><p>Replace Section 6.1 with the following:</p><p>Sample the aggregate in accordance with WTM R90. The mass of the field sample shall be the mass shown in WTM R90 Table 1.</p></td></tr>
<tr><td>6.3</td><td><p>Replace Section 6.3 with the following:</p><p>Fine Aggregate – The size of the test sample of aggregate after drying shall be 500 g minimum.</p></td></tr>
<tr><td>6.4 and Table</td><td><p>Replace Section 6.4 and the table after Section 6.4 with the following:</p><p>Coarse Aggregate – The mass of the test sample of coarse aggregate shall conform with the following (after drying):</p>
<table>
<tr><th>Nominal Maximum Aggregate Size</th><th>Minimum Weight of Sample, g</th><th>Minimum Weight of Sample, lb.</th></tr>
<tr><td>> 2 in. (50mm)</td><td>25,000</td><td>55</td></tr>
<tr><td>2 in. (50mm)</td><td>20,000</td><td>44</td></tr>
<tr><td>1 ½ in. (37.5mm)</td><td>15,000</td><td>33</td></tr>
<tr><td>1 ¼ in. (31.75mm)</td><td>10,000</td><td>22</td></tr>
<tr><td>1 in. (25mm)</td><td>10,000</td><td>22</td></tr>
<tr><td>¾ in. (19mm)</td><td>5,000</td><td>11</td></tr>
<tr><td>½ in. (12.5mm)</td><td>2,500</td><td>5.5</td></tr>
<tr><td>⅜ in. (9.5mm)</td><td>1,000</td><td>2.2</td></tr>
</table></td></tr>
</table>

6.5

Replace Section 6.5 with the following:

Coarse and Fine Aggregate Mixtures –

Mixtures of Fine and Coarse Aggregate for Base Course - the unwashed sample must be separated on a No. 4 sieve, the two portions weighed, and the relative proportions determined. The portion passing the No. 4 sieve must be reduced by use of the riffle splitter or quartering procedures to a sample weighing a minimum of 1 lb. (500g).

Wash the sample proportions according to the table below:

Type of Material	Retained on #4 (4.75mm)	Passing #4 (4.75mm)*
Base Course Materials	Washed	Washed
3-inch Dense Graded Base Course Material	Unwashed	Washed
Granular and Structural Backfill and Subbase	Unwashed	Washed
MSE Wall Backfill Material (Standardized Special Provision) **	Unwashed	Washed

*See Standard Specification for instances where the sample could be unwashed.

** The R4 material component is dry sieved and the percent passing for each sieve calculated based on the dry unwashed sample weight of the R4. This includes sieving of any materials that remain in the pan after sieving. Record the cumulative percent passing for all sieves as weighed except for the #200 (0.075mm) sieve. The total of the R4 dry unwashed weight is recorded as the #200 (0.075mm) weight. This way there is 0% contribution calculated from the R4 component.

7.1

Replace Section 7.1 with the following:

If the test sample has not been subjected to testing by WTM T11, dry it to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15 minute intervals until there is less than 0.1percent mass loss. Determine and record the mass of material that will be placed on the sieves to the accuracy of the balance as defined in Section 6.1.

If there is recycled material in the sample, the drying temperature is 100°C (212°F) or less. Samples containing RAP are dried in the oven only.

7.2

Add the following to Section 7.2:

For samples weighing 11 lb. (5,000g) or more, it is recommended that sieves for coarse aggregate fractions be mounted in 12-inch or larger frames, or the sieving may be done in increments using the standard 8-inch diameter sieves.

9.2

Replace Section 9.2 with the following:

NOTE: For Structural and Granular Backfill, the R4 sieves (Percent Passing) are calculated using the entire sample mass, the P4 (Percent Passing) sieves are calculated using the P4 mass only.

Report final percentages according to the following table:

Type of Material	All sieves except #200 (0.075mm)	#200 (0.075mm) sieve
Base Course & Aggregate used in Concrete	Nearest whole number	0.1
Aggregate used in HMA or HMA extractions	0.1	0.1

WTM T84

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T84 ***Standard Method of Test for Specific Gravity and Absorption of Fine Aggregate*** with the following modifications:

<table>
<tr><th>AASHTO T84-22 Section</th><th colspan="3">WisDOT Modification:</th></tr>
<tr><td>2.1</td><td colspan="3"><i>Replace the AASHTO R76, R90, T11, T85, and T255 references with the following WisDOT Modified versions:</i>
WTM R76 – Reducing Samples of Aggregate
WTM R90 – Sampling of Aggregate
WTM T11 – Finer than No. 200
WTM T85 – Coarse Aggregate Specific Gravity
WTM T100 – Specific Gravity of Soils
WTM T255 – Moisture Content</td></tr>
<tr><td>3.1.1</td><td colspan="3"><i>Replace Section 3.1.1 with the following:</i>
<i>absorption</i>—the increase in the mass of aggregate due to water in the pores of the material, but not including water adhering to the outside surface of the particles, expressed as a percentage of the dry mass. The aggregate is considered “dry” when it has reached a constant mass. To achieve constant mass, dry the test sample to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15 minute intervals until there is less than 0.1percent mass loss.</td></tr>
<tr><td rowspan="4">7.1</td><td colspan="3"><i>Replace Section 7.1 with the following:</i>
Obtain a minimum of 1,000 g of the fine aggregate from the sample using the applicable procedure described in WTM R76.
If testing a RAP sample, the material must be extracted prior to conducting this test.
When WTM T84 and WTM T85 are conducted on the same sample, recalculate the final Specific Gravity according to Section 13.4 of this Standard.</td></tr>
<tr><td>Sieve Analysis of Entire Sample</td><td>Test Method Required</td><td>Cut Sieve between Coarse and Fine</td></tr>
<tr><td>Less than 10% passing the #4 (4.75mm) sieve.</td><td rowspan="2">WTM T85</td><td>#4 (4.75mm) Sieve</td></tr>
<tr><td>More than 10% passing the #4 (4.75mm) sieve but less than 10% passing the #8 (2.36mm) sieve.</td><td>#8 (2.36mm) Sieve</td></tr>
</table>

<table>
<tr><td rowspan="2"></td><td>More than 10% passing the #4 (4.75mm) sieve and 10-90% passing the #8 (2.36mm) sieve.</td><td>WTM T84 **and** WTM T85</td><td>#4 (4.75mm) or #8 (2.36mm) Sieve</td></tr>
<tr><td>More than 90% passing the #8 (2.36mm) sieve.</td><td>WTM T84</td><td>#4 (4.75mm) Sieve</td></tr>
<tr><td>8.2</td><td colspan="3">*Replace Section 8.2 with the following:*
Partially fill the pycnometer with water. Immediately introduce into the pycnometer 500 ± 10 g of SSD fine aggregate prepared as described in Section 7 and fill with additional water to approximately 90% of capacity. Manually roll, invert, and agitate or use a combination of these actions to eliminate all air bubbles in the pycnometer (Note 3). Adjust its temperature to 23.0 ± 1.7°C (73.4 ± 3°F), if necessary, by immersion in circulating water, and bring the water level in the pycnometer to its calibrated capacity. Determine total mass of the pycnometer, specimen, and water.
Note 3—It normally takes about 15 to 20 min to eliminate air bubbles by manual methods. Dipping the tip of a paper towel into the pycnometer has been found to be useful in dispersing the foam that sometimes builds up when eliminating the air bubbles. Adding a few drops of isopropyl alcohol, after removal of air bubbles and just prior to bringing the water level to its calibrated capacity, has also been found useful in dispersing foam on the water surface. Do not use isopropyl alcohol when using the alternative method described in Section 8.2.1.</td></tr>
<tr><td>13.3</td><td colspan="3">*Add Section 13.3 with the following:*
The intent is to have one sample with two separate tests. Two separate test samples, within the acceptable range of two test results (Table 1 in Section 8.2), are required for a valid test.</td></tr>
<tr><td>13.4</td><td colspan="3">*Add Section 13.4 with the following:*
When both the WTM T84 and 85 are performed on the same sample, the combined Specific Gravity and Absorption will be calculated based on the percent retained and percent passing of the Cut Sieve (from Section 7.1 above).
The following equation shall be used for determining Specific Gravity and Absorption:
WTM T84 = Fine Aggregate Gsb, SSD Gsb, Gsa or Absorption
WTM T85 = Coarse Aggregate Gsb, SSD Gsb, Gsa or Absorption
Percent Retained = Percent retained on Cut Sieve
Percent Passing = Percent passing on Cut Sieve
Combined Specific Gravity or Absorption = (T85 x Percent Retained) + (T84 x Percent Passing)</td></tr>
</table>

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WTM T85

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Revised Date: 09/13/2023

Follow AASHTO T85 ***Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate*** with the following modifications:

<table>
<tr><th>AASHTO T85-22 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO R76, R90, T27, T84, and T255 references with the following WisDOT Modified versions:</i>
WTM R76 – Reducing Samples of Aggregate
WTM R90 – Sampling of Aggregate
WTM T27 – Sieve Analysis
WTM T84 – Fine Aggregate Specific Gravity
WTM T255 – Moisture Content</td></tr>
<tr><td>3.1.1</td><td><i>Replace Section 3.1.1 with the following:</i>
<i>absorption</i>—the increase in the mass of aggregate due to water in the pores of the material, but not including water adhering to the outside surface of the particles, expressed as a percentage of the dry mass. The aggregate is considered “dry” when it has reached a constant mass. To achieve constant mass, dry the test sample to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15 minute intervals until there is less than 0.1percent mass loss.</td></tr>
<tr><td>7.2</td><td><i>Replace Section 7.2 with the following:</i>
Thoroughly mix the sample of aggregate and reduce it to the approximate quantity needed using the applicable procedures in WTM R 76. Thoroughly wash the material used in the coarse fraction, to remove dust or other coatings from the surface.   Based on the WTM T27 gradation of the sample, follow the table below to determine when T84 and/or T85 should be performed.
When WTM T84 and WTM T85 are conducted on the same sample, recalculate the final Specific Gravity according to Section 9.2 of this Standard.
<table>
<tr><th>Sieve Analysis of Sample</th><th>Test Method Required</th><th>Cut Sieve between Coarse and Fine</th></tr>
<tr><td>Less than 10% passing the #4 (4.75mm) sieve.</td><td rowspan="2">WTM T85</td><td>#4 (4.75mm) Sieve</td></tr>
<tr><td>More than 10% passing the #4 (4.75mm) sieve but less than 10% passing the #8 (2.36mm) sieve.</td><td>#8 (2.36mm) Sieve</td></tr>
</table></td></tr>
</table>

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	More than 10% passing the #4 (4.75mm) sieve and 10-90% passing the #8 (2.36mm) sieve.	WTM T84 **and** WTM T85	#4 (4.75mm) or #8 (2.36mm) Sieve
	More than 90% passing the #8 (2.36mm) sieve.	WTM T84	#4 (4.75mm) Sieve
7.3	*Add the following to Section 7.3:* FRAP/RAP Samples must be extracted prior to testing.		
10.1	*Add the following to Section 10.1:* The intent is to have one sample with two separate tests. Two separate test sample replicates, within the acceptable range of two test results, are required for a valid test.		
10.4	*Add Section 10.4 with the following:* When both the WTM T84 and 85 are performed on the same sample, the combined Specific Gravity and Absorption will be calculated based on the percent retained and percent passing of the Cut Sieve (from Section 7.1 above). The following equation shall be used for determining Specific Gravity and Absorption: WTM T84 = Fine Aggregate Gsb, SSD Gsb, Gsa or Absorption WTM T85 = Coarse Aggregate Gsb, SSD Gsb, Gsa or Absorption Percent Retained = Percent retained on Cut Sieve Percent Passing = Percent passing on Cut Sieve Combined Specific Gravity or Absorption = (T85 x Percent Retained) + (T84 x Percent Passing)		

WTM T96

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Revised Date: 09/13/2023

Follow AASHTO T96 ***Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine*** with the following modifications:

Note: AASHTO T96 is a modification of ASTM C131. There are instances where this WisDOT modification affects both AASHTO T96 and ASTM C131, as noted below.

<table>
<tr><th>AASHTO T96-22 (2019) Section</th><th>WisDOT Modification:</th></tr>
<tr><td>1.</td><td><i>Replace the AASHTO(ASTM) T27(C136), R76(C702) and R90(D75) references with the following WisDOT Modified versions:</i>
WTM R76 – Reducing Samples of Aggregate
WTM R90 – Sampling of Aggregate
WTM T27 – Sieve Analysis</td></tr>
<tr><td>5.</td><td><i>Replace Section 3.2 with the following:</i>
<i>Constant Mass</i> – Dry the test sample to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15-minute intervals until there is less than 0.1 percent mass loss.</td></tr>
<tr><th>ASTM C131-20 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>6.5.1</td><td><i>Replace the first paragraph and table in Section 6.5.1 with the following:</i>
The charge (steel spheres or ball bearings), (Note 6) depending upon the grading of the test sample as described in Section 8, shall be as follows:
<table>
<tr><th>Grading</th><th>Number of Spheres</th><th>Mass of Charge, g</th></tr>
<tr><td>A</td><td>12</td><td>5000 ± 25</td></tr>
<tr><td>B</td><td>11</td><td>4580 ± 25</td></tr>
<tr><td>C</td><td>8</td><td>3330 ± 20</td></tr>
</table></td></tr>
<tr><td>7.1</td><td><i>Revise Section 7.1 to replace the reference to ASTM D75 with the WTM R90 reference, and to replace the reference to ASTM C702 with the WTM R76 reference.</i></td></tr>
<tr><td>8.1</td><td><i>Replace Section 8.1 with the following:</i>
Wash the reduced sample in accordance with WTM T 27, and oven dry to a constant mass according to Section 2 of this procedure (above). Separate into individual size fractions, and recombine to the grading of Table 1 most nearly corresponding to the range of sizes in the aggregate as furnished for the work. Record the mass of the sample prior to test to the nearest 0.1 gram.</td></tr>
</table>

Table 1

Replace Table 1 in Section 9. with the following:

Sieve Size		Mass of indicated Sizes, g		
Passing	Retained	Grading		
		A	B	C
37.5mm	25.0mm	1250 ± 25		
25.0mm	19.0mm	1250 ± 25		
19.0mm	12.5mm	1250 ± 10	2500 ± 10	--
12.5mm	9.5mm	1250 ± 10	2500 ± 10	2500 ± 10
9.5mm	4.75mm	--	--	2500 ± 10
Total		5000 ± 10	5000 ± 10	5000 ± 10

9.1

Replace Section 9.1 with the following:

Place the test sample and the charge in the Los Angeles testing machine and rotate the machine at a speed of 30 to 33 r/min for 100 revolutions (Note 7). After the 100 revolutions, discharge the material from the machine and sieve over a #12 (1.70mm) sieve. Record the weight of sample retained on the # 12 sieve to the nearest 0.1 g. Place entire sample (including material found to be passing the #12 (1.70mm) sieve after initial 100 revolutions) back inside of the testing machine, along with the charge, and complete the final 400 revolutions.

After the final 400 revolutions, discharge the material from the machine and sieve over a #12 (1.70mm) sieve in a manner conforming to WTM T27. Record the weight of sample retained on the #12 sieve to the nearest 0.1 g.

Wash material retained on the #12 (1.70mm) sieve and oven-dry to a constant mass. Sieve the dried sample over the #12 (1.70mm) and record the mass retained to the nearest 0.1 g (Note 8). Report the percentage of loss by abrasion and impact to the nearest 0.1%.

WTM T103

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T103 ***Standard Method of Test for Soundness of Aggregates by Freezing and Thawing*** with the following modifications:

AASHTO T103-22 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO T27 reference with the following WisDOT Modified version:* WTM T27 – Sieve Analysis
3.1.6	*Replace Section 3.1.6 with the following:* *Temperature-Measuring Equipment* - shall consist of thermometers, resistance thermometers, or thermocouples, capable of measuring the temperature at various points within the testing chamber and at the centers of a sample container. The thermometers, resistance thermometers, or thermocouples shall have an approximate range from -26 to 50°C (-15 to 120°F), readable and accurate to 1.0°C (1.8°F) Data storage devices are required and shall be capable of sampling temperature measurements every ten minutes for the duration of the test.
4.1 & 4.1.1	*Remove Sections 4.1 & 4.1.1 – Fine Aggregate.*
4.2	*Replace Section 4.2 with the following:* *Coarse Aggregate* – Coarse aggregate for the test shall consist of plus #4 (4.75mm) sieve size material. For WisDOT source approval, sample stockpiles with 100% passing the 1-1/2 in. (37.5mm) sieve.
4.4	*Replace the first paragraph of Section 4.4 with the following:* The coarse aggregate sample will have all the material that passes the #4 (4.75mm) sieve removed. The balance of the sample will conform to the ranges in the following table. If the sample contains less than 5% on any size specified in the following table, that size will not be tested.
5.1 & 5.1.1	*Remove Sections 5.1 and 5.1.1 – Fine Aggregate*
6.	*Add the following to Section 6.:* WisDOT requires testing according to Procedure B – Partial Immersion with Methyl Alcohol.
6.1, 6.1.1 & 6.1.2	*Remove Sections 6.1, 6.1.1 and 6.1.2: Method A*
6.2.1	*Replace Section 6.2.1 with the following:*

	In this procedure, the samples shall be placed in a vacuum chamber and saturated by subjecting them to an air pressure of not over 3.4 kPa (25.4mm of mercury) and breaking the vacuum with a sufficient amount of 0.5% (by mass) solution of methyl alcohol in water to completely cover the samples. The samples shall be left in the solution for 15 minutes.
6.2.2	*Replace Section 6.2.2 with the following:* The samples shall then be removed from the vacuum chamber. Coarse aggregates shall be placed one layer deep in shallow pans containing ¼ in. (6.4mm) of the methyl alcohol solution and frozen in this condition.
6.2.4	*Add Section 6.2.4 with the following:* Each sample fraction container shall be placed in the freeze apparatus. Samples shall be covered and placed a minimum of 6 inches above the base of the apparatus and shall have a minimum of 1 inch clear space around the entire sample (shelf not included). The sample shall be cooled until the temperature at the center of the sample reaches -23 ± 3°C (-9 ± 5°F). A minimum of one temperature probe per freezer shall be placed in the center of a sample while freezing and thawing. A minimum of one fan shall circulate air within the freezer during each freezing cycle. A thermometer or thermocouple shall be suspended in the center of the freezer (in air). The air temperature in the freezer shall not decrease below -28°C (-18°F). Air surrounding the specimen while thawing shall not increase above 30°C (85°F). The temperature at the center of the sample shall be held constant at the low temperature for a minimum of 2 hours before the start of the thaw cycle. Upon completion of a freeze cycle, the temperature at the center of the sample shall be raised to 21 ± 3°C (70 ± 5°F) and shall be held at the constant thawed temperature for a minimum of 30 min.
6.3 & 6.3.1	*Remove Sections 6.3 and 6.3.1: Partial Immersion in Water*
7.1	*Replace Section 7.1 with the following:* Alternate freezing and thawing shall be repeated until the required number of cycles is obtained. One test cycle consists of one freeze cycle and one thaw cycle. Repeat the procedure of alternate freezing and thawing for 16 cycles. One complete cycle shall not exceed 24 hours. If the test is interrupted, the sample shall remain covered in a thawed state until testing is resumed. The sample shall remain partially immersed during the test.
9.1.3	*Replace Section 9.1.3 with the following:* Calculate the weighted average for each fraction based on the sample's WTM T27 gradation based on the following two options: OPTION 1: If ≥ 5% on the ¾ in. (19.0mm) Sieve
9.1.3	Sample Fraction Size

	Passing the 1 ½ in. (37.5mm) to Retained on the ¾ in. (19.0mm)	Weighted Multiplier
	Passing the ¾ in. (19.0mm) to Retained on the ⅜ in. (9.5mm)	35%
	Passing the ⅜ in. (9.5mm) to Retained on the #4 (4.75mm)	45%
	OPTION 2: If < 5% on the ¾ in. (19.0mm) Sieve	20%
	Sample Fraction Size	
	Passing the 1 ½ in. (37.5mm) to Retained on the ¾ in. (19.0mm)	Weighted Multiplier
	Passing the ¾ in. (19.0mm) to Retained on the ⅜ in. (9.5mm)	0%
	Passing the ⅜ in. (9.5mm) to Retained on the #4 (4.75mm)	65%

WTM T104

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Revised Date: 09/13/2023

Follow AASHTO T104 *Standard Method of Test for Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate* **with the following modifications**:

AASHTO T104-22 Section	WisDOT Modification:
2.1	*Replace the AASHTO T27 reference with the following WisDOT Modified version:* WTM T27 – Sieve Analysis
4.1	*Replace Section 4.1 with the following:* Prepare the solution for immersion of test samples using sodium sulfate in accordance with Section 4.1.1. The volume of the solution shall me at least five times the solid volume of all samples immersed at any one time.
4.1.1	*Replace Section 4.1.1 – Sodium Sulfate Solution with the following:* The solution shall be at least five times the solid volume of the test samples. Add and dissolve salt in water at 77°F (25°C) minimum to saturation so that salt crystals are present when the solution is ready for use. Keep container covered when access is not needed. Let solution cool to 68.5 to 71.5°F (20.3 to 21.9°C). Stir again and let stand for 48 hours prior to use. Before each use, break up the salt cake in the container and stir. When used, the solution shall have a specific gravity not less than 1.154 nor more than 1.171. Discard a discolored solution or filter it and check for specific gravity. AASHTO recommends the use of not less than 225g/liter of sodium sulfate.
5.1 & 5.1.1	*Remove Sections 5.1 & 5.1.1 – Fine Aggregate*
5.3	*Remove Section 5.3*
6.1	*Remove Section 6.1 – Fine Aggregate*
7.2	*Replace Section 7.2 with the following:* *Drying Samples after Immersion* – After the immersion period, remove the aggregate sample from the solution, permit it to drain for 15 ± 5 min, and place in the drying oven. The temperature of the oven shall have been brought previously to 110 ± 5°C (230 ± 9°F). Dry the samples to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15 minute intervals until there is less than 0.1percent mass loss. After constant mass has been achieved, allow the samples to cool to 20 to 25°C (68 to 77°F) (Note 10), when they shall again be immersed in the prepared solution as described in Section 7.1. Cooling may be aided by the use of an air conditioner or fan. Temperature of the material shall be checked by

thermometer or other acceptable means before placing the material in the soaking solution.

Note 9—Drying time required to reach constant mass may vary considerably for several reasons. Efficiency of drying will be reduced as cycles accumulate because of salt adhering to particles and, in some cases, because of increase in surface area due to breakdown. The different size fractions of aggregate will have differing drying rates. The smaller sizes will tend to dry more slowly because of their larger surface area and restricted interparticle voids, but this tendency may be altered by the effects of container size and shape.

Note 10 **–** Experience has shown that sample temperatures significantly different than the solution temperature of 21.1°C (70.0°F) may change the temperature of the solution temporarily, thereby causing a change in salt saturation even though the solution returns to 21.1°C (70°F) for most of the soaking period. This may cause erroneous results.

7.3

Replace Section 7.3 with the following:

Number of Cycles—Repeat the process of alternate immersion and drying for 5 cycles. Preferably, the test shall be performed continuously until the specified number of cycles is obtained. However, if the test must be interrupted, leave the samples in the oven at 110 ± 5°C (230 ± 9°F) until the testing can be resumed.

8.1.2

Replace Section 8.1.2 with the following:

After the sodium sulfate has been removed, dry each fraction of the sample to constant mass as defined in Section 7.2 above. Sieve the coarse aggregate over the sieve shown below for the appropriate size of particle. For coarse aggregate, sieving shall be by hand, with agitation sufficient only to assure that all undersize material passes the designated sieve. No extra manipulation shall be employed to break up particles or cause them to pass the sieves. Determine the mass of the material retained on each sieve and record each amount. The difference between each of these amounts and the initial mass of the fraction of the sample tested is the loss in the test and is to be expressed as a percentage of the initial mass for use in Table 2.

Sieve of Aggregate	Sieve Used to Determine Loss
2 ½ in. to 1 ½ in. (63mm – 37.5mm)	1 ¼ in. (31.5mm)
21 ½ in. to ¾ in. (37.5mm – 19.0mm)	⅝ in. (16.0mm)
¾ in. to ⅜ in. (19.0mm – 9.5mm)	5/16 in. (8.0mm)
⅜ in. to # 4 (9.5mm – 4.75mm)	# 5 (4.0mm)

10.1.3 – 10.1.3.6

Replace Sections 10.1.3 through 10.1.3.6 with the following:

Calculate the weighted average for each fraction based on the sample's WTM T27 gradation based on the following two options:

OPTION 1: If ≥ 5% on the ¾ in. (19.0mm) Sieve

Sample Fraction Size	Weighted Multiplier
Passing the 1 ½ in. (37.5mm) to Retained on the ¾ in. (19.0mm)	35%
Passing the ¾ in. (19.0mm) to Retained on the ⅜ in. (9.5mm)	45%
Passing the ⅜ in. (9.5mm) to Retained on the #4 (4.75mm)	20%

OPTION 2: If < 5% on the ¾ in. (19.0mm) Sieve

Sample Fraction Size	Weighted Multiplier
Passing the 1 ½ in. (37.5mm) to Retained on the ¾ in. (19.0mm)	0%
Passing the ¾ in. (19.0mm) to Retained on the ⅜ in. (9.5mm)	65%
Passing the ⅜ in. (9.5mm) to Retained on the #4 (4.75mm)	35%

WTM T113

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Follow AASHTO T113 ***Standard Method of Test for Lightweight Pieces in Aggregate*** with the following modifications:

<table>
<tr><th>AASHTO T113-22 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO R76, R90, T27, T84, and T85 references with the following WisDOT Modified versions:</i>
WTM R76 – Reducing Samples of Aggregate
WTM R90 – Sampling of Aggregate
WTM T27 – Sieve Analysis
WTM T84 – Fine Aggregate Specific Gravity
WTM T85 – Coarse Aggregate Specific Gravity</td></tr>
<tr><td>5.1.1</td><td><i>Remove Section 5.1.1</i></td></tr>
<tr><td>5.1.2</td><td><i>Replace Section 5.1.2 with the following (keep Note 2):</i>
A solution of zinc bromide in water. Mix the zinc bromide with water until a specific gravity of 2.45 is reached.
NOTE: If reusing the solution, verify the specific gravity before each new test.</td></tr>
<tr><td>6.1</td><td><i>Replace the table in Section 6.1 with the following:</i>
<table>
<tr><th>Nominal Maximum Aggregate Size</th><th>Minimum Weight of Sample, g</th></tr>
<tr><td># 4 (4.75mm)</td><td>200</td></tr>
<tr><td>¾ in. (19.0mm)</td><td>3,000</td></tr>
<tr><td>1.5 in. (37.5mm)</td><td>5,000</td></tr>
<tr><td>3 in. (75mm)</td><td>10,000</td></tr>
</table></td></tr>
<tr><td>6.3 – 6.3.4</td><td><i>Remove Sections 6.3 – 6.3.4 – Fine Aggregates</i></td></tr>
<tr><td>7.1 – 7.1.7</td><td><i>Remove Sections 7.1 – 7.1.7 – Fine Aggregates</i></td></tr>
<tr><td>7.2.5</td><td><i>Replace Section 7.2.5 with the following:</i>
Wash the lightweight particles over the #4 (4.75mm) sieve with water to remove the heavy liquid solution. Ensure the sample is thoroughly washed and all of the heavy liquid solution is removed.
Wash the lightweight particles over a sieve finer than a #4 (4.75mm) with water to remove the heavy liquid solution. Ensure the sample is thoroughly washed and all the heavy liquid solution is removed.</td></tr>
</table>

WTM T255

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T255 ***Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying*** with the following modifications:

<table>
<tr><th>AASHTO T255-22 (2021) Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO R90, T84 and T85 references with the following WisDOT Modified versions:</i>
WTM R90 – Sampling of Aggregates
WTM T84 – Fine Aggregate Specific Gravity
WTM T85 – Coarse Aggregate Specific Gravity</td></tr>
<tr><td>6.1</td><td><i>Replace Table 1 – Sample Size of Aggregate with the following:</i>
<table>
<tr><th>Aggregate Type</th><th>Minimum Sample Size</th></tr>
<tr><td>Fine Aggregate</td><td>1 lb. (500 g)</td></tr>
<tr><td>Coarse Aggregate or Dense Graded Aggregate</td><td>5.5 lb. (2500 g)</td></tr>
</table></td></tr>
<tr><td>7.2</td><td><i>Replace Section 7.2 with the following:</i>
Dry the material by heating at a moderate temperature (230º F or less), until it has given up all free and absorbed moisture and has reached a constant weight. To achieve constant mass, dry the test sample to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15 minute intervals until there is less than 0.1 percent mass loss. Occasional stirring with a spoon may accelerate the drying, but care must be taken not to lose any of the sample clinging to the spoon.</td></tr>
</table>

WTM T304

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T304 ***Standard Method of Test of Uncompacted Void Content of Fine Aggregate*** with the following modifications:

AASHTO T304-22 Section	**WisDOT Modification:**
1.2.2	*Remove Section 1.2.2. – Individual Size Fractions (Method B)*
1.2.3	*Remove Section 1.2.3. – As-Received Gradation (Method C)*
2.1	*Replace the AASHTO R76, R90, T11, T27 and T84 references with the following WisDOT Modified versions:* WTM R76 – Reducing Samples of Aggregate WTM R90 – Sampling of Aggregate WTM T11 – Finer that No. 200 WTM T27 – Sieve Analysis WTM T84 – Fine Aggregate Specific Gravity

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WTM D4791

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow ASTM D4791 ***Standard Method of Test for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate*** with the following modifications:

<table>
<tr><th>ASTM D4791-19 (2023) Section</th><th>WisDOT Modification:</th></tr>
<tr><td>1.1</td><td><i>Add the following to Section 1.1:</i>
This test may be performed with the same sample used in determining WTM D5821 - Fractured Particles when both tests are required.</td></tr>
<tr><td>2.1</td><td><i>Replace the ASTM C136, C702 and D75 references with the following WisDOT Modified versions:</i>
WTM R76 – Reducing Samples of Aggregate
WTM R90 – Sampling of Aggregate
WTM T27 – Sieve Analysis</td></tr>
<tr><td>7.2</td><td><i>Replace Section 7.2 to the following:</i>
Thoroughly mix the sample and reduce it to an amount suitable for testing using the applicable procedures described in WTM R76. The sample for test shall be approximately the mass desired when dry and shall be the end result of reduction.</td></tr>
<tr><td>8.2</td><td><i>Replace Section 8.2 with the following:</i>
Aggregate from a washed sieve analysis (WTM T27) may be used to create a sample for Flat and Elongated testing. Use the following table to determine the sample size fraction, based on the final product:
<table>
<tr><th>Final Product</th><th>Sample Size Fraction</th></tr>
<tr><td>CABC</td><td>Retained on the #4 (4.75mm) sieve</td></tr>
<tr><td>HMA</td><td>Retained on the #4 (4.75mm) sieve</td></tr>
<tr><td>PCC</td><td>Retained on the ⅜ in. (9.5mm) sieve</td></tr>
</table>
Further reduce the retained material sample according to WTM R76, until 400 or more individual aggregate particles remain.
Spread the dried test sample on a clean flat surface large enough to permit careful inspection of each particle. Obtain the total dry weight of the test sample and record that weight.</td></tr>
<tr><td>8.3 – 8.3.2</td><td><i>Remove Section 8.3 through Section 8.3.2 – Method A</i></td></tr>
<tr><td>8.4</td><td><i>Add the following to the beginning of Method B:</i>
WisDOT Requires Method B - Flat and Elongated Test</td></tr>
</table>

9.1	*Replace Section 9.1 with the following:* Calculate and report the percentage of particles, by weight, found to exceed the specified ratio for flat & elongated particles to the nearest 1% in accordance with the following equation: $P = \left(\frac{FE}{FE + NFE}\right) * 100$ $TS = FE + NFE$ Where: P = Percentage of particles considered to be flat & elongated FE = Weight of flat & elongated particles NFE = Weight of particles not flat & elongated TS = Weight of total test sample
10	*Replace all of Section 10 with the following:* Report the specific ratio of length to thickness criteria against which the sample was evaluated and the specified limit for flat & elongated particles for the type of material tested. Report the total weight of the coarse aggregate sample tested.

WTM D5821

Effective with January 2025 Letting
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Follow ASTM D5821 ***Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate*** with the following modifications:

ASTM D5821-13 (2017) Section	**WisDOT Modification:**
1.1	*Add the following to Section 1.1:* This test may be performed with the same sample used in determining WTM D4791 – Flat and Elongated, when both tests are required.
2.1	*Replace the ASTM C136, C702 and D75 references with the following WisDOT Modified versions:* WTM R76 – Reducing Samples of Aggregate WTM R90 – Sampling of Aggregate WTM T27 – Sieve Analysis
7.2	*Replace Section 7.2 with the following:* Split the sample until 400 or more individual aggregate particles remain.
8.3	*Replace Section 8.3 with the following:* Separate the sampled particles into categories based on whether a particle: - Has the required number of fractured faces - Does not meet the specified fracture criteria - Has questionable or borderline face
8.4	*Replace Section 8.4 with the following:* Following the division of all sampled particles into the categories, determine the count of particles in the fractured category, the count of particles in the questionable category, and the count of particles not meeting the specified fracture criteria.
9.1	*Replace Section 9.1 with the following:* Calculate and report the percentage of particles, by count, found to have the specified numbers of fractured faces to the nearest 1% in accordance with the following: $P = \left(\frac{F + \left(\frac{Q}{2}\right)}{(F + Q + N)} \right) * 100$ $TS = F + Q + N$

	P = Percentage of particles with the specified number of fractured faces F = Count of particles with at least the specified number of fractured faces Q = Count of particles in the questionable or borderline category N = Count of particles in the uncrushed category not meeting the fractured particle criteria TS = Total sample particle count
9.3	*Replace Section 9.3 with the following:* Report the total count of the coarse aggregate sample tested.

WisDOT Test Procedure (WTP) A-001

Effective with January 2025 Letting
Revised Date: 12/02/2024

WisDOT Test Procedure for Field Determination of Moisture Content of Fine and Coarse Aggregates

This procedure is for determining the moisture content of fine and coarse aggregates in the field.

Section	**WisDOT Procedure:**
1.	***Apparatus***
1.1	• Suitable pan for weighing samples. • A scale or balance readable to 0.1% of the sample weight. • A hot plate or field stove of sufficient size capable of maintaining a uniform temperature.
2.	***Sample Requirements***
2.1	The size of the sample must be at least 1 lb. (500 g) for fine aggregate and 5.5 lb (2500 g) for coarse aggregate or a mixture of fine and coarse aggregates.
3.	***Procedure***
3.1	After obtaining a representative sample of the material to be tested by standard size reduction procedure, place the sample in a suitable tared container and obtain the weight of the wet sample and container. Record this weight as: W_W = Weight of container plus wet material
3.2	Dry the material by heating at a moderate temperature (230º F or less), until it has given up all free and absorbed moisture and has reached a constant weight. To achieve constant mass, dry the test sample to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15 minute intervals until there is less than 0.1percent mass loss. Occasional stirring with a spoon may accelerate the drying, but care must be taken not to lose any of the sample clinging to the spoon.
3.3	Remove the container from the hot plate or stove and weigh carefully. This weight is recorded as: D_W = Weight of container plus dry material T = Weight of container
4.	***Calculations***
4.1	**Calculate Moisture Percentage** The percent moisture is calculated as follows:

	$\frac{(W_w - D_w)}{(D_w - T)} X\ 100$
5.	***Report***
5.1	The calculations in section 4.1 must be made to determine the moisture content percentage. Document the results.

WisDOT Test Procedure (WTP) A-002

Effective with January 2025 Letting
Revised Date: 12/02/2024

WisDOT Field Test Procedure for Sieve Analysis of Aggregates

This test procedure is for determining the particle size distribution of fine aggregates, coarse aggregates, and mixtures of fine and coarse aggregates.

Note: For the purposes of these procedures, coarse aggregate is material retained on the No.4 sieve, and fine aggregate is material passing the No. 4 sieve. A graded base course material is an example of a mixture of fine and coarse aggregate.

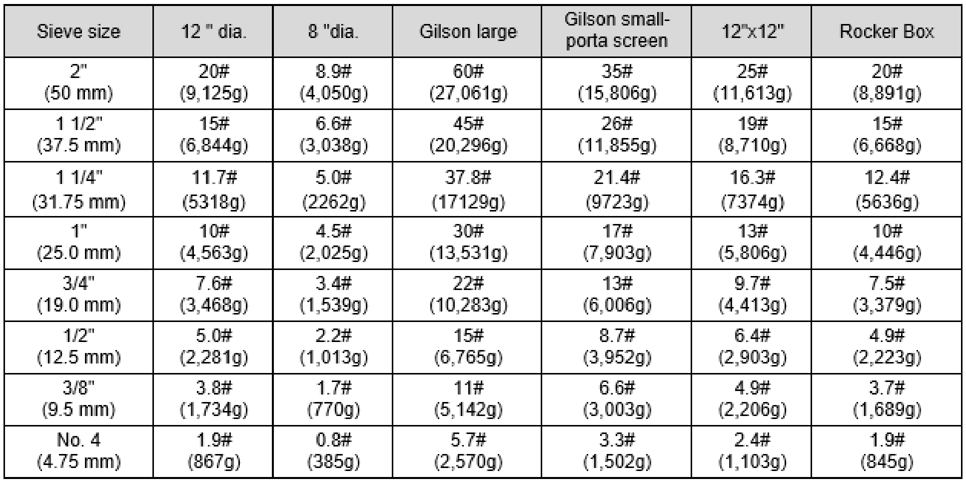
Section	WisDOT Procedure:
1.	***Apparatus***
1.1	**Balances** • The balance(s) or scale(s) must be sensitive to within 0.2% of the weight of the total sample to be tested. **Sieves (Washing)** • A nest of two sieves must be used for washing the sample. The lower is a #200 sieve, with a #16 sieve above it. **Sieves (Gradation)** • Suitable sieve sizes must be selected to furnish the information required by the specifications covering the material to be tested. The sieves must conform to Wire-Cloth Sieves for Testing Purposes, AASHTO Designation: E11. • The open screen area for the large Gilson screens is 14.75" x 22.75". The small Gilson screens have a screen area of 14" x14". The average open screen area of WisDOT rocker boxes is 10.5" x 10.5". • The limit for loading on the 8-inch diameter and 12-inch diameter sieves for the minus No. 4 sieves is 227 (say 200 grams) and 511 (say 500 grams), respectively. The loads in table 860-5 are calculated from information taken from AASHTO T-27 (ASTM C136). Minus No. 4 sieve loads are calculated based on a maximum of 0.01 lb/in2 (7 Kg/M2). • Sieves must be mounted on substantial frames constructed in a manner that will prevent loss of material during sieving. **Washing Container** • A bucket, pail, or vessel large enough to contain the sample when covered with water and to allow vigorous agitation without inadvertent loss of any part of the sample of water is required. The containers should be kept clean. **Drying Equipment** • An oven, hot plate, stove, or other device for heating and drying the sample uniformly and as rapidly as possible without damaging the aggregate will be

needed. Samples should be stirred frequently in order to prevent popping or baking of aggregate. The drying pan should be large enough to allow manipulation during drying of the aggregate without loss by spilling. The drying pan should be kept clean.

2 *Allowable Loadings on Sieves*

2.1 The table below provides guidance on the maximum allowable weight on sieves. The amount of material retained on the overloaded sieve may be regulated by the introduction of a sieve having larger openings than in the critical sieve, or by sieving in increments.

Allowable Loadings on Sieves



Sieve size	12 " dia.	8 "dia.	Gilson large	Gilson small-porta screen	12"x12"	Rocker Box
2" (50 mm)	20# (9,125g)	8.9# (4,050g)	60# (27,061g)	35# (15,806g)	25# (11,613g)	20# (8,891g)
1 1/2" (37.5 mm)	15# (6,844g)	6.6# (3,038g)	45# (20,296g)	26# (11,855g)	19# (8,710g)	15# (6,668g)
1 1/4" (31.75 mm)	11.7# (5318g)	5.0# (2262g)	37.8# (17129g)	21.4# (9723g)	16.3# (7374g)	12.4# (5636g)
1" (25.0 mm)	10# (4,563g)	4.5# (2,025g)	30# (13,531g)	17# (7,903g)	13# (5,806g)	10# (4,446g)
3/4" (19.0 mm)	7.6# (3,468g)	3.4# (1,539g)	22# (10,283g)	13# (6,006g)	9.7# (4,413g)	7.5# (3,379g)
1/2" (12.5 mm)	5.0# (2,281g)	2.2# (1,013g)	15# (6,765g)	8.7# (3,952g)	6.4# (2,903g)	4.9# (2,223g)
3/8" (9.5 mm)	3.8# (1,734g)	1.7# (770g)	11# (5,142g)	6.6# (3,003g)	4.9# (2,206g)	3.7# (1,689g)
No. 4 (4.75 mm)	1.9# (867g)	0.8# (385g)	5.7# (2,570g)	3.3# (1,502g)	2.4# (1,103g)	1.9# (845g)

3. *Sample Requirements*

3.1 Field samples for sieve analysis must be reduced to testing size using a riffle splitter, quartering method, or miniature stockpile method for damp fine aggregate only. See tables below “Minimum Sample Weights for Aggregates” for required sizes of field samples. The field samples to be reduced must be thoroughly mixed, and the fine aggregate must be in a slightly moist condition. The test sample must be approximately the weight required as indicated in the following sections, and must be the end result of reduction from the larger field sample by either using a riffle splitter, quartering method, or miniature stockpile method for damp fine aggregate only. The selection of samples of exact predetermined weight must not be attempted.

Fine Aggregate

Samples of fine aggregate for sieve analysis must weigh, after drying, a minimum of 1 lb. (500 grams).

Coarse Aggregates and Mixtures of Coarse and Fine Aggregate

Samples of coarse aggregate or mixtures of coarse and fine aggregate for sieve analysis must weigh, after drying, not less than the amount indicated in table below.

Minimum Sample Weights for Aggregates

Nominal Maximum Size of Particles[1]	Minimum Weight of Sample[2], g	Minimum Weight of Sample[2], lb.
3/8" (9.5 mm)	1,000	2.2
1/2" (12.5 mm)	2,500	5.5
3/4" (19.0 mm)	5,000	11
1" (25.0 mm)	10,000	22
1 1/4"(31.75 mm)	10,000	22
1 1/2" (37.5 mm)	15,000	33
2" (50.0 mm)	20,000	44
> 2" (greater than 50 mm)	25,000	55

If for coarse concrete aggregates, a washed analysis is made only for determining the amount of material passing the No. 200 (75µm) sieve, the test sample may be reduced to the minimum sizes shown in table below.

Minimum Sample Weights for P200 Test

Nominal Maximum Size of Particles[1]	Minimum Weight of Sample[2], g	Minimum Weight of Sample[2], lb.
3/4" - 1" (19.0 -25mm)	2,500	5.5
1-1/2" (37.5 mm) or over	5,000	11

[1] The nominal maximum particle size is defined as the nominal maximum size as indicated by the appropriate specification or description. If the specification or description does not indicate a nominal maximum size (for example a sieve size indicating 90-100% passing), use the maximum size (that sieve indicating 100% passing).

[2] For samples weighing 11 lb. (5,000g) or more, it is recommended that sieves or coarse aggregate fractions be mounted in 12-inch or larger frames or the sieving may be done in increments using the standard 8-inch diameter sieves.

3. *Procedure*

3.1 Procedure for Fine or Coarse Aggregates for Concrete Masonry

1. The test sample must be thoroughly dried.
2. After drying, cooling, and weighing, the sample must be placed in the container and sufficient water added to cover it. It is desirable to use as much water as possible to reduce the number of decantations needed. When clay balls or clay coatings on the aggregate particles are noted, the sample must be allowed to soak at least 10 minutes before to agitating and decanting. When aggregates have a particularly heavy or tight coating, it may be desirable to add a very small quantity of organic wetting agent (such as a household detergent) to the initial wash water.
3. The contents of the container must be agitated vigorously, and the wash water poured promptly over the nested sieves arranged with the coarser sieve on top. For dirty aggregates, it may be necessary to wait 10 to 15 seconds before decanting the wash water to avoid blocking the openings of the No. 200 sieve. When the No. 200 sieve becomes blocked, it may be reopened by back-washing the material retained on the No. 200 sieve into the drying pan. Agitation should be sufficiently vigorous to completely separate all of the passing the No. 200

material from other particles and to bring all the passing the No. 200 fraction into suspension in order that it will be removed by decantation of the wash water. Twisting of the pail handle will usually not result in vigorous enough action.

Using a large spoon to stir and agitate the aggregate in the wash water has been found most acceptable. Care must be taken to avoid, as much as possible, the decantation of the coarse particles of the sample. The operation must be repeated until the wash water is substantially clear.

4. All material retained on the nested sieves must be returned to the washed sample. The washed aggregate must again be thoroughly dried.

   When performing this test to determine the percentage of material passing the #200 sieve (AASHTO T11) follow the calculation procedure described below. Calculations for the percent of material that passed the #200 sieve during washing should be made as follows:

$$\left(\frac{(Original\ Dry\ Weight - Washed\ Dry\ Weight)}{Original\ Dry\ Weight}\right) \times 100 = Percent\ Passing\ The\ \#200\ Sieve$$

   When performing this test to determine sieve gradation requirements, cool the sample to prevent damage to the sieves, and place the washed and dried sample over a nest of sieves as required by the specifications with any additional sieves added to prevent overloading of the individual sieves. Follow the guidelines provided in the Materials Testing Guide to limit the quantity of material on a given sieve so that all particles have opportunity to reach sieve openings a number of times during the sieving operation. The sieving operation must be conducted by means of a lateral and vertical motion of the sieve, accompanied by jarring action so as to keep the sample moving continuously over the surface of the sieve. In no case should fragments in the sample be manipulated through the sieve by hand. Sieving must be continued until not more than 1% of the weight of the material retained on a given sieve passes that sieve during one minute of hand sieving.

   On that portion of the sample retained on the No. 4 and larger sieves, the procedure described above for determining thoroughness of sieving must be carried out with a single layer of material. When mechanical sieving is used, the thoroughness of sieving must be tested by using the hand method of sieving described above.

5. Calculations for the gradation of the washed sample should be made as follows:

$$\text{Percent Retained} = \frac{\text{Weight (2)}}{\text{Weight (1)}} \text{ x 100}$$

Percent Passing

= 100 - % Retained

Weight (1) is initial weight of the dried unwashed sample, and Weight (2) is dry weight, after sieving, of the washed sample cumulatively retained on each sieve.

3.2 Additional Procedure for Mixtures of Fine and Coarse Aggregates for Base Course

1. The unwashed test sample must be thoroughly dried. Materials containing portions of reclaimed or recycled materials, when the materials would be altered by heat in the drying process, should be spread and air or oven dried at a temperature of 100 degrees F or less.
2. After cooling, the sample must then be separated on a No. 4 sieve, the two portions weighed, and the relative proportions determined.
3. The portion passing the No. 4 sieve must be reduced by use of the riffle splitter or quartering procedures to a sample weighting approximately 1 lb. (500g).
4. The material retained on the No. 4 sieve and the test sample of the material passing the No. 4 sieve must then be washed, dried, (recycle and reclaim content - air or oven dry 100 degrees F or less), cooled, and sieved separately in accordance with the procedure previously discussed. For 3-inch dense graded base course material only the material passing the No. 4 sieve needs to be washed.

3.3 Additional Procedure for Granular and Structural Backfill and Subbase

1. The sample size must meet the minimum requirements of table 860-2(field sample) and table 860-6 (laboratory sample) based on the nominal maximum size of aggregate in the R4 component of the sample. The unwashed test sample must be thoroughly dried.
2. After cooling, the sample must then be separated on a No. 4 sieve, the two portions weighed, and the relative proportions determined.
3. The material retained on the No. 4 sieve is sieved and the percent passing for each sieve calculated based on the total dry unwashed sample weight.
4. The portion passing the No. 4 sieve must be reduced by use of the riffle splitter or quartering procedures to a sample weighting approximately 1 lb. (500g).
5. The test sample of the material passing the No. 4 sieve must then be washed and dried.

3.4 Additional Procedure for MSE Wall Backfill Material

This procedure is used when certain percentage of the fine aggregate sieves need to comply with the specification based on the total sample and the percent passing the No. 200 sieve is based only on the percent passing the No. 4 sieve.

1. The sample size must meet the minimum requirements of table 860-1 (field sample) and table 860-6 (laboratory sample) based on the nominal maximum size of aggregate in the R4 component of the sample. The unwashed test sample must be thoroughly dried.
2. After cooling, the sample must then be separated on a No. 4 sieve, the two portions weighed, and the relative proportions determined.
3. The R4 material component is dry sieved and the percent passing for each sieve calculated based on the dry unwashed sample weight of the R4. This includes sieving of any materials that remain in the pan after sieving. Record the cumulative percent passing for all sieves as weighed except for the #200 sieve. The total of the R4 dry unwashed weight is recorded as the #200 weight. This way there is 0% contribution calculated from the R4 component.

4. The portion passing the No. 4 sieve must be reduced by use of the riffle splitter or quartering procedures to a sample weighting approximately 1 lb. (500g).
5. The test sample of the material passing the No. 4 sieve must be weighed, washed, dried, cooled and sieved.

4. *Reporting Requirements*

4.1 Reporting Requirements for Fine or Coarse Aggregates for Concrete Masonry

The electronic Materials Tracking System (MTS) provides the prefix 162, fine and coarse aggregates for concrete worksheet that should be utilized for calculating and reporting tests.

Final gradation results are calculated to the nearest 0.1% for all sieves. However, when results are reported, percentages are rounded off to the nearest whole percent except for the percent passing the No. 200 sieve, which is reported to the nearest 0.1% and administered in accordance with the specification requirements.

All tabulations of these gradation data should clearly indicate whether washed or unwashed testing was used.

4.2 Report Requirements for Mixtures of Fine and Coarse Aggregates for Base Course

The electronic Materials Tracking System (MTS) provides the prefix 217, aggregates testing worksheet that should be used for calculating and reporting tests. When using non-electronic methods calculations of gradation for washed analysis should be made as illustrated in the following and in figure 860-1.

DT1348, Sieve analysis for Mixture of Fine and Coarse Aggregates, should be used make these calculations orderly and accurately.

Final gradation results are calculated to the nearest 0.1% of all sieves. When results are reported, percentages are rounded off to the nearest whole percent, except for the percent passing the No. 200 sieve, which is reported to the nearest 0.1% and administered in accordance with the specification requirements.

All tabulations of these gradation data should clearly indicate whether washed or unwashed testing was used.

For DT1348 example calculations, see CMM Figure 860-1.

4.3 Report Requirements for Granular and Structural Backfill and Subbase

The electronic Materials Tracking System (MTS/MIT) provides the prefix 217, aggregates testing worksheet that should be used for calculating and reporting tests. The following example illustrates the calculations for backfill testing.

Calculation of the R4 sieve components is based on the total sample and is done unwashed. The P4 washed sieve analysis is based on the reduced dry unwashed sample and stands alone. R4 and P4 sieve results are individually compared to the specifications as cited in Standard Specification section 209.

	When reporting granular backfill results indicate use as either trench backfill or bedding backfill. This defines the general requirements of the material. The term "trench" backfill is also applicable to materials used for backfilling excavations for frost heave or other unstable materials, such as marsh backfill etc, when specified.
4.4	**Report Requirements for MSE Wall Backfill Material** The electronic Materials Tracking System (MTS/MIT) provides the prefix 217, aggregates testing worksheet that should be used for calculating and reporting tests. Material selected should be type Dense Graded Base- 3-Inch. A specification for the MSE Wall Backfill Material is available for selection. For entry screen guidance and example calculations, see CMM 860.9.5 Example 5.

WisDOT Test Procedure (WTP) A-003

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WisDOT Test Procedure for Field Density Testing by the Sand Cone Method

This procedure is for determining density of the materials in the field using a sand cone method.

Additional guideline for this test procedure is provided in CMM 860.12.

Section	**WisDOT Procedure:**
1.	***Apparatus***
1.1	The equipment necessary for the field density test should include the following: (The first eight items may be included in a kit for field use.) • 6-inch sand cone and 1-gallon glass jar. 4-inch cones and 1/2-gallon jars are not acceptable.) • 1-gallon container with tight fitting lid (to hold excavated soil) • 12" x 12" metal density plate with four large spikes for hold-downs • Large screwdriver and geologist's hammer (wood handle) to loosen materials. • Large spoon with sharpened edges (for excavating material) • Small trowel (to prepare test hole surface) • Small paint brush (to sweep and collect loose material) • Shovel, square-end, D-handle (to level test area) The following equipment may be kept in a field laboratory: • 20 kg solution balance or field scale, 35 lb. capacity. If a solution balance is used it will be necessary to convert kilogram or gram weights to pounds if reported in lbs./cubic foot. • Gram scale, 2,000 g capacity • Gasoline, electric or gas stove • Drying pan approximately 9" x 12" • Pie pan • No. 4 sieve (to determine percent gravel and for specific gravity sample) • Sand scope (for filling glass jars) • Supply of dry density sand 100 lb bags • Field density data forms • Gasoline can with flexible pouring spout (for gasoline stove) The following items are optional: • Cardboard manila tags (for tagging gallon soil containers) • Wax marking pencils (to mark apparatus and other equipment) • Clipboard (to hold forms) The term "apparatus" as used in these procedures refers to the glass jar with the sand cone attached.

2. *Calibration*

2.1 Calibration of Density Sand

1. Using containers with volume known or computed by actual measurement: C.B.R. mold - 6" diameter, 4.59" depth; volume 1/13.33 cubic foot. Mortar bucket - volume 1/10 cubic foot.
    a. Weigh the container.
    b. Fill the apparatus (glass jar with cone) with dry, clean density sand.
    c. Close the valve.
    d. Invert the apparatus and place it over the container so that the inside of the cone rests on the rim edge of the container. If the container is larger in area than the sand cone, place the metal plate that accompanies the apparatus over the container and set the sand cone apparatus on the plate.
    e. Holding the apparatus in place; open the valve and allow sand to flow into container. Avoid jarring or vibrating the container.
    f. When the sand stops flowing, close the valve and remove apparatus and plate carefully.
    g. Using a straightedge, strike off the surface of the sand level with the rim of the container. Avoid jarring or vibrating container when striking off.
    h. Tap the sides of the container to settle sand and thus avoid possible spilling or losing of sand from the container when transferring to scales.
    i. Brush excess sand off the outside of any protruding parts of the container.
    j. Weigh the container and sand.
    k. Determine net weight of sand: J minus A.
    l. Calculate unit weight of sand: Unit weight of sand in pounds per cubic foot = net weight of sand divided by volume of container.
2. Using 1-gallon glass jar and glass plate or other containers with slightly curved or tapered sides: volume determined using cold water 35 F - 60 F
    a. For weight of sand filling container:
        i. Weigh glass jar.
        ii. Invert a filled density apparatus (glass jar with cone and sand), and place onto the glass jar.
        iii. Open valve and allow the sand to flow into the glass jar (avoid jarring or vibration).
        iv. When the sand stops flowing, close the valve.
        v. Remove the density apparatus carefully.
        vi. Using the straightedge, carefully strike off the surface of the sand level with the top rim of the jar (avoid jarring or vibrating jar with straightedge during this operation).
        vii. Weigh the glass jar with the sand.
        viii. Determine net weight of sand: Step 7 minus Step 1.
    b. For volume of jar:
        i. Weigh glass jar with glass plate.
        ii. Fill the glass jar with cold water to the top rim of the jar neck.
        iii. Place the glass plate on the jar (to eliminate excess water caused by surface tension).
        iv. Dry the surface of the jar and glass plate.

   v. Weigh the jar with water and glass plate.
   vi. Determine net weight of water: Step 5 minus Step 1.
   vii. Volume of jar = net weight water divided by in pounds divided by 62.4 pcf. Sand unit weight = net weight of sand divided by volume of jar.

3. Using sand cone apparatus: 1-gallon glass jar with rubber gasket and sand cone attached.
   a. Find weight of the sand filling the apparatus:
      i. Weigh empty glass jar with cone and rubber gasket.
      ii. Pour density sand into inverted apparatus through open valve until jar and valve are full. During this operation, try to keep the cone full of sand. Avoid jarring or vibrating the apparatus while sand is flowing until the valve is closed.
      iii. Close the valve.
      iv. Remove the excess sand in the cone.
      v. Weigh the jar with the cone and sand.
      vi. Determine the net weight of the sand: Step 5 minus Step 1.
   b. Find volume of the apparatus:
      i. Weigh empty jar with rubber gasket and sand cone.
      ii. Pour cold water into inverted density apparatus through open valve until water appears in the cone.
      iii. Close valve, remove the excess water, and dry the cone and outside surface of apparatus.
      iv. Weight the apparatus with the water.
      v. Determine net weight of water: Step 4 minus Step 1 in pounds.
      vi. Volume of apparatus (including valve) = net weight of water divided by (62.4 pcf).
      vii. Unit weight of sand = net weight of sand in pounds divided by volume of apparatus.

2.2 Calibration of Cone and Plate

1. Fill the glass jar with density sand and attach sand cone.
2. Weigh the glass jar with the density sand and attached cone.
3. Set the density plate on a smooth level surface.
4. Invert the apparatus and seat the sand cone in the hole of the plate.
5. Open the valve and allow sand to flow into the cone until it stops (avoid jarring or vibrating apparatus while sand is flowing).
6. Close the valve.
7. Re-weigh the apparatus (jar and cone) and remaining sand.
8. Determine net weight of sand used to fill the cone and plate. Step 2 minus Step 7.
9. Record this weight as the weight of sand filling cone.

2.3 Spot-Check Calibration

The spot-check calibration should be performed for each new bag of density sand.

1. Follow the procedures outlined Section 2.2: Calibration of Cone and Plate.
2. If the weight of the sand filling the cone is ±13.6 g (0.03 lbs) from the original cone calibration, recalibrate the density sand.

3. *Procedure*

3.1 Preparation Preliminary to Test

1. Spot-check sand density using calibrated sand cone.
2. Recalibrate density sand, if necessary.
3. Fill all necessary glass jars with the calibrated sand to a constant weight.
4. Record the weight of each filled glass jar (always weigh filled jar with or without cone attached. Be consistent in procedure to avoid errors when several jars are used at one time).
5. Weigh and record the weight of all soil containers.
6. Assemble necessary equipment required in the field (take along extra filled jars in case hole dug is unusually large).

3.2 Performing the Field Density Test

1. Remove all loose and dry soil from the surface of the site to be tested. Go below depth disturbed by machinery.
2. Trim to a smooth, level surface an area large enough for the density plate to bed firmly. (If the surface is gravelly and irregular, sprinkle just enough fine material, scraped from the surrounding area or passing the No. 4 sieve, over the area to fill the surface voids; then smooth and compact with a trowel. Do not place a bedding layer for the plate thicker than 1/4").
3. Set the density plate firmly in place.
4. Loosen the soil with a screwdriver or geologist's pick and carefully remove the soil with a spoon.
5. Dig the test hole carefully, in such a manner that the material surrounding the hole is neither compacted nor loosened.
6. Place all soil from the hole into the airtight container.
7. Using a brush, gently sweep all loose particles from the sides of the hole and around the top edge of the plate hole into the hole. Remove and place all particles into the soil container.
8. Seal the container to prevent moisture loss from sample.
9. Invert the apparatus with the valve closed and set it onto the plate (make sure the lip of the cone edge is properly seated in the groove of the plate before opening valve).
10. Open the valve and allow the sand to flow into the hole and cone until it stops (there should be no vibration from earth-moving equipment in the immediate area until the valve is closed).
11. Close the valve and remove the apparatus with the remaining sand.
12. Weigh the apparatus with the remaining sand and record the weight to the nearest 5 g (0.01 lb). (When outside, shield the scale from the wind. Maintain a level scale.)
    The glass jar with the remaining sand should be weighed either with or without the cone attached.
13. To find the weight of the sand filling the hole and the cone, subtract the remaining weight of apparatus and sand from the original weight of apparatus and sand.
14. The weight of sand filling the hole is found by subtracting the weight of sand filling the cone from the weight of sand filling the hole and the cone: Step 13 minus cone calibration.

15. The volume of the soil sample (hole) is found by dividing the weight of sand filling the hole by the weight per cubic foot of the density sand: Step 14 divided by sand density.
16. Weigh the soil sample and container. When outside, shield the scale from the wind. Maintain a level scale.
17. Record the weight to the nearest 5 g (0.01 lb).
18. Find weight of wet soil: Step 16 minus weight of soil container.
19. Determine dry weight and gravel content of total soil sample:
    a. When time allows, the total wet soil sample may be dried for greater accuracy:
        i. Dry the entire sample to a constant weight. Manipulate and stir the soil; pulverize any clay lumps for more complete and rapid drying.
        ii. Weigh the total dry sample to the nearest 5 g (0.01 lb) and record.
        iii. For gravel content, pass total sample over No. 4 sieve. Make sure gravel retained contains no clay lumps.
        iv. Weigh the gravel fraction retained on the No. 4 sieve to the nearest 5 g (0.01 lb) and record.
        v. Find percent gravel content: Weight of gravel retained multiplied by 100 and the result divided by dry weight of total sample. Step 4 multiplied by 100 and divided by Step 2.
    b. When time does not allow drying the total soil sample, or if the material does not contain an appreciable amount of gravel, a representative sample may be taken as follows:
        i. Thoroughly mix the total wet soil sample.
        ii. Select a representative sample for moisture and gravel content according to the following:

Suggested Minimum Size of Moisture Content Samples		
Maximum Particle Size	Moisture Content Sample, lb.	Moisture Content Sample, g
No. 4 Sieve	0.22	100
1/2" Sieve	0.55	250
1" Sieve	1.1	500
2" Sieve	2.2	1,000

        iii. Weigh the moisture content sample and record the weight to the nearest 0.1 g.
        iv. Dry the moisture content sample to a constant weight. For sandy soils, manipulate and stir. Pulverize any clay lumps for more complete and rapid drying. For clay soils, begin stirring and manipulating immediately upon heating to prevent the formation of a hard crust and to allow internal moisture to escape.
        v. Weigh the dry sample and again record weight to nearest 0.1 g.
        vi. Find weight of moisture loss: Weight wet sample minus weight dry sample. Step 3 minus Step 5.
        vii. Determine percent moisture content: Weight of moisture loss multiplied by 100 and the result divided by dry weight of sample. Step 6 times 100 divided by Step 5.
        viii. For dry weight of total sample: Total dry weight = total wet weight divided by (1.0 + % moisture/100.)

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- ix. For gravel content: Pass dried moisture content sample over the No. 4 sieve (make sure material retained on No. 4 sieve contains no hardened clay lumps).
- x. Weigh gravel portion retained on No. 4 sieve to nearest 0.1 g and record.
- xi. Find the percent gravel content: Weight of the gravel retained multiplied by 100 and the result divided by the dry weight of the moisture content sample: Step 10 times 100 divided by Step 3.

In the case of fine-grained soils which contain no gravel, the "Speedy" moisture device may be used for a quick determination of the moisture content.

20. Specific gravity of gravel: If not previously known, the specific gravity of the gravel may be determined by the method described in AASHTO Designation: T85.
21. Find dry density of field soil sample:

$$\boxed{\text{English : Dry density, pcf} = \frac{\text{Dry weight total sample, lbs.}}{\text{Volume of hole, cf.}}}$$

22. Correct standard maximum density if gravel content of field sample differs from laboratory compaction sample by 5% or more.
23. Percent compaction:

$$\boxed{\text{Percent Compaction} = \frac{\text{Field density}}{\text{Corrected standard density}}(100)}$$

4. *Calculations*

4.1

1. Volume of density apparatus (jar with sand cone attached):

$$\boxed{\text{Volume, cf.} = \frac{\text{Weight of water filling jar, lbs.}}{\text{62.4 lbs./cf.}}}$$

2. Unit weight of sand:

$$\boxed{\text{Density, lbs./cf.} = \frac{\text{Weight of sand filling container, lbs.}}{\text{Volume of container, cf.}}}$$

3. Volume of test hole:

$$\boxed{\text{Volume, cf.} = \frac{\text{Weight of sand filling hole, lbs.}}{\text{Unit weight of sand, lbs./cf.}}}$$

4. Moisture content:

$$\boxed{\text{Moisture, \%} = \frac{\text{Wetweight - dry weight}}{\text{Dry weight}}(100)}$$

5. Dry weight of soil sample from hole:

$$\boxed{\text{Dry weight (lbs.)} = \frac{\text{Wet weight sample, lbs.}}{\frac{1 + \text{\% moisture}}{100}}}$$

6. Dry density of soil sample from hole:

$$\boxed{\text{Dry density, lbs./cf.} = \frac{\text{Dry weight, lbs.}}{\text{Volume of test hole, cf.}}}$$

7. Percent of standard laboratory density:

$$\boxed{\% = \frac{\text{Field density}}{\text{Corrected standard density}}(100)}$$

5. Laboratory Standard Density Correction for Variation in Gravel Content

5.1 These instructions pertain to using the nomograph as a guide for grading inspectors and others concerned with field compaction.

By referring to the nomograph with the specific gravity of the aggregate and a laboratory compaction density of the material, the inspector can establish the standard maximum density for a field sample containing a certain gravel content. The field density can then be compared with the standard density and the percent of compaction determined.

The nomograph can be found in CMM 860.12.1 as Figure 860.4. For example calculations using the nomograph to determine maximum density refer to CMM 860.13.6 example 5.

6. *Report*

6.1 The calculations in section 4.1 must be made to determine the dry density of soil sample and percent compaction. Document the results.

WTM R74

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO R74 ***Standard Practice for Wet Preparation of Disturbed Soil Samples for Test*** with the following modifications**:**

AASHTO R74-16 (2020) Section	**WisDOT Modification:**
Section 1.2	*Replace Section 1.2 with the following:* Method A provides for drying the field samples at a temperature not exceeding 60°C (140°F), making a wet separation of the 0.425-mm (No. 40) sieve and drying to a temperature not exceeding 60°C (140°F).
Section 7	*Remove Section 7 – Method B*

WTM T89

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T89 ***Standard Method of Test for Determining the Liquid Limit of Soils*** with the following modifications:

AASHTO T89-22 Section	**WisDOT Modification:**
4.1	*Replace Sections 4.1 with the following:* A sample with a mass of about 100 g shall be taken from the thoroughly mixed portion of the material passing the 0.425-mm sieve that has been obtained in accordance with WTM R74.
11., 12., 13. and 14.	*Remove Sections 11, 12, 13, and 14, and all subsequent sections – Method B*

WTM T99

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T99 ***Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop*** with the following modifications:

AASHTO T99-21 (2021) Section	**WisDOT Modification:**
2.1	*Replace the references to AASHTO R76, T85 and T255 with the following WisDOT Modified versions:* WTM R76 – Reducing Samples of Aggregate WTM T85 – Coarse Aggregate Specific Gravity WTM T255 – Moisture Content WTM T310 – In-Place Density of Soil
13.1	*Add the following to Section 13.1:* All Proctor tests must have a minimum of 5 points, 2 ascending and 2 descending, with 1 point at or near the optimum moisture.

WTM T100

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T100 ***Standard Method of Test for Specific Gravity of Soils*** with the following modifications:

<table>
<tr><th>AASHTO T100-15 (2019) Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the references to AASHTO T85 with the following WisDOT Modified versions:</i>
WTM T85 – Coarse Aggregate Specific Gravity</td></tr>
<tr><td>Table 1</td><td><i>Replace Table 1 with the following:</i>
Report Specific Gravity based on water at 20°C (68°F)
<table>
<tr><th>Temperature</th><th>Relative Density of Water</th><th>Correction Factor <i>K</i></th></tr>
<tr><td>20°C (68°F)</td><td>0.9982343</td><td>1.0000</td></tr>
</table>
</td></tr>
</table>

WTM T180

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T180 ***Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop*** with the following modifications:

AASHTO T180-22 Section	WisDOT Modification:
2.1	*Replace the references to AASHTO R76, T85 and T255 with the following WisDOT Modified versions:* WTM R76 – Reducing Samples of Aggregate WTM T85 – Coarse Aggregate Specific Gravity WTM T255 – Moisture Content WTM T310 – In-Place Density of Soil
13.1	*Add the following to Section 13.1:* All Proctor tests must have a minimum of 5 points, 2 ascending and 2 descending, with 1 point at or near the optimum moisture.

WTM T310

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T310 ***Standard Method of Test for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*** with the following modifications:

AASHTO T310-19 Section	**WisDOT Modification:**
1.1	*Replace the Section 1.1 with the following:* This test method describes the procedure for determining the in-place density and moisture of soil and soil- aggregate by use of nuclear gauge. The density of the material may be determined by Direct Transmission. The moisture of the material is determined only from measurements taken at the surface of the soil (i.e., backscatter).
2.1	*Replace the AASHTO T99, T180 and T191 references with the following WisDOT Modified versions:* WTM T99 – Standard Proctor Using 5.5 lb. Hammer WTM T180 – Modified Proctor Using 10 lb. Hammer
Note 1	*Remove Note 1*
4.1.5	*Replace Section 4.1.5 with the following:* Other radioactive sources must not be within 10 m (30 ft) of the gauge in operation. The operator must not be within 1 m (3 ft), and any bystanders must not be within 5 m (15 ft).
5.9	*Add Section 5.9 with the following:* In addition to certification of the operator, the department requires that all individual nuclear moisture / density gauges used on WisDOT projects be on the approved list. This policy applies to all WisDOT, consultant, and contractor gauges used for acceptance or QMP density testing. Each gauge must be within 30 years of the Cesium-137 manufacture date as identified on the gauge's source plate or handle.
6.	*Replace Section 6. – **Hazards**, with the following:* The State of Wisconsin Department of Health Services (DHS), Radiation Protection Section issues a license to WisDOT specifying that use of radioactive gauges by the department be supervised by the WisDOT Radiation Safety Officer (RSO). The RSO must be kept informed of the location and usage activities of WisDOT nuclear gauges at all times. The WisDOT RSO contact information will be supplied to each user of a WisDOT nuclear density gauge.

	The WisDOT RSO may be contacted at the following telephone numbers: (608) 516-6359, Primary (715) 421-8002, Wisconsin Rapids Office Nuclear gauge owners are responsible for compliance with State of Wisconsin DHS Radioactive Materials license or NRC license requirements. In addition, they must comply with WisDOT requirements when engaged in work on WisDOT projects. Personnel who either use nuclear gauges or directly supervise the use of gauges must be trained in radiation safety and transportation of radioactive materials and must maintain the appropriate Highway Technician Certification Program (HTCP) certifications.
6.1	*Replace Section 6.1 with the following:* **Lost or Stolen Gauges:** If a gauge is lost or stolen, notify the Radiation Safety Officer (RSO) as soon as possible. The RSO will notify the appropriate regulatory agency per DHS 157.
6.2	*Replace Section 6.2 with the following:* **Damaged Gauges:** The operator will follow these procedures in the event of gauge damage (per DHS 157 Appendix H). All companies must have available an appropriate radiation survey meter in accordance with http://docs.legis.wisconsin.gov/code/admin_code/dhs/110/157.pdf • Seal off the area for a distance of 15 feet around the gauge in question to prevent exposure to themselves and others. Protect the gauge from further damage. • Stop the vehicle or heavy piece of equipment that is involved, it must be detained in order to verify that it is not contaminated. • Never let the gauge in question be left unattended. • Visually inspect the gauge to determine the extent of the damage to the source(s), source housing(s), and shielding. Check the base of the gauge for any splits or punctures. Take Pictures, take notes and statements to document incident. • Do not handle the gauge if it has been damaged severely enough that source rod or internal shielding is cracked or broken open. • Notify the Radiation Safety Officer (or notify supervisor who will contact the RSO) as soon as possible. The RSO will notify the appropriate regulatory agency. • Follow the instructions of the RSO

7.1	*Replace Section 7.1 –* ***Calibration****, with the following:* Each gauge must be calibrated and verified annually and before each construction season as follows: 1. Calibrate the gauge by a manufacturer approved calibration service provider. 2. Then additionally verify calibration of the gauge using BTS gauge blocks Contact the WisDOT RSO for appointment scheduling and for current year procedures. This procedure must be repeated if the gauge is sent in for any manufacturer calibration or service during the construction season. WisDOT maintains an annual list of consultant's and contractor's certified gauges approved to perform nuclear testing on WisDOT administered projects. Consultants and contractors must be on this list to perform acceptance and nuclear gauge testing on WisDOT projects. This list is established and maintained by the Quality Assurance Unit in central office and is on the APL. To verify that the department has the correct information for your company, you must submit the following information yearly: 1. Current copy of your Wisconsin Agreement State License or your Federal Nuclear Regulatory Commission (NRC) license. 2. Copies of current nuclear moisture and density gauge 3 block calibration certificates (5 blocks for other states) conducted by the manufacturer or an approved calibration service. 3. Company contact person, RSO, or safety officer (please update as changes occur). 4. The WisDOT Block Calibration form (including new constants). Please send this information to: Wisconsin Department of Transportation Bureau of Technical Services, Truax Center ATTN: WisDOT RSO 3502 Kinsman Blvd Madison WI 53704-2507 (Note: email is the primary means of sending this information)
8.2	*Add the following to Section 8.2:* **Standardization:** The operator will take new standard counts for density and moisture at the project. (Note: it is important to check the standard counts daily to account for changing conditions, change of material, and to check gauge performance. An incorrect moisture count will cause a gauge to incorrectly determine density. This check should be done daily on all manufacturers' gauges such as Troxler, CPN, Humboldt, Seaman and so forth).
8.2.1	*Add the following to Section 8.2.1:*

	Gauges must be warmed up and checked following the manufacturer's guidelines.
8.2.2	*Remove Section 8.2.2*
8.2.3	*Remove Section 8.2.3*
8.3	*Add Section 8.3 – **QMP QC and QV Nuclear Density Gauge Comparison**:* **For All QMP Tested Materials:** On Soils, Sand & Gravel, Recycled Materials, Stabilized Bases, etc., select a representative section of the compacted material on or before the first day of placement for the comparison process. Compare the 2 or more gauges used for QC and QV density measurements in BS or in DT mode. The QC and QV gauge operators will perform 5 four-minute density tests at jointly determined sites. Record the density measurement of each test site for the QC, QV and other acceptance gauges. Calculate the average of the difference in dry density between the QC and QV gauges of the 5 test sites. If the average dry density difference exceeds 1.5 pcf investigate the cause, perform a new reference standard count, and conduct a second gauge comparison procedure. The 5 jointly determined sites in the second gauge comparison do not need to be the same as those used in the first comparison. If the second gauge comparison procedure also results in an average difference exceeding 1.5 pcf, replace one or more gauges and repeat the comparison process. Operators can use the moisture bias procedure as described in section 9.7 as a trouble shooting process if gauges don’t adequately compare. If a bias is needed for one or both gauges this needs to be checked during placement or if the material classification changes.
8.4	*Add Section 8.4 with the following: **Reference Site Monitoring*** **Required for All Projects with Nuclear Density Testing:** After performing the gauge comparison on soils, establish a project reference site approved by the department. Clearly mark a flat surface of concrete or asphalt or other material that will not be disturbed for the duration of the project. Perform 5 four-minute density tests in BS mode with each gauge at the project reference site and calculate the average density value for each gauge to establish each gauge's reference value. Use the gauge's reference value as a control to monitor the calibration of the gauge for the duration of the project. Check each gauge on the project reference site a minimum of once per day during placement of all materials placed within the 1:1 roadway core slopes on the project and compare it to the gauge’s reference value. Maintain the reference site test data for the gauge at an agreed location. Calculate the difference between the gauge's daily test result and its reference value. Investigate if a daily test result is not within 1.5 pcf of its reference value. Conduct 3 additional tests at the reference site once the cause of the deviation is corrected. Calculate and record the average of the 3 additional

	tests, if applicable. Remove the gauge from the project if the 3-test average is not within 1.5 pcf of its reference value. If the department supplies a ValiDator II for the established project reference site, conduct 3 initial four- minute density tests in DT mode at all depths that will be tested in the field. Use the gauge reference value as a control to monitor the calibration of the gauge for the duration of the project. Check each gauge on the project ValiDator II a minimum of once per day at each testing location during placement of materials on the project. Calculate the difference between the gauge's daily test result and its reference value. Investigate if a daily test result is not within 1.0 pcf of its reference value. Conduct 3 additional four-minute tests at the reference site once the cause of the deviation is corrected. Calculate and record the average of the 3 additional tests. Remove the gauge from the project if the 3-test average is not within 1.0 pcf of its reference value.
9.5.1	*Replace Section 9.5.1 with the following:* ***Material Testing Procedure:*** When testing soils or aggregate; prepare an area sufficient in size to accommodate the gauge. Remove all loose and disturbed material and plane the area to a smooth, flat, and level condition to obtain maximum contact between the gauge and the material being tested. When a void exceeds 1/8 in. in depth, the operator must use native fines or fine sand to fill these voids and then smooth the surface with a rigid plate or other suitable tool. The area filled beneath the gauge should not exceed 10% of the total area.
9.5.2	*Add to Section 9.5.2 with the following:* Position the gauge handle and perform testing in either BS mode or in DT mode at 4-inch, 6-inch, or 8-inch depths. The gauge test depth is set according to the thickness of the lift placed.
9.5.4	*Add the following to Section 9.5.4:* If there is a possibility that the pilot hole will collapse during testing, then use the backscatter test mode.
9.5.5	*Add the following to Section 9.5.5:* Prepare the test site and check the gauge for rocking.
9.5.6	*Add the following to Section 9.5.6:* The gauge's test probe should be set as close to the bottom of the compacted lift as possible without extending into the underlying lift.
9.5.9	*Add the following to Section 9.5.9:* All soil and base course (including recycled asphalt, recycled concrete, cold in-place recycled (CIR) asphalt material, etc.) are tested using 1 one-minute test per location.

9.5.10	*Replace Section 9.5.10 with the following:* Determine the in-place density by reading the gauge.
9.6	*Add the following to Section 9.6:* After each test, the operator must remove the material below the gauge and check for any visible voids, cobbles, or organics that could have affected the test results.
9.7	*Add Section 9.7 with the following:* **Establishing a Moisture Density Gauge Bias for Soils and Base:** A density gauge measures the moisture content simultaneously with the density of a material. A moisture bias represents the average difference in moisture content between in-situ nuclear gauge measurements and the oven-dried samples for a particular nuclear gauge and a particular type of material. Use the procedure below, corresponding with the gauge type, to establish the correct gauge bias for any particular type of soil or base. 1. On a compacted soil having a uniform moisture content, measure the density and moisture at two different locations using the density gauge. 2. Obtain a soil sample from each test location (150 to 200 g) from directly beneath the center of the gauge footprint. 3. Weigh each wet sample. Oven-dry wet sample at 100° C, until the sample weight remains constant. Calculate the moisture content (Msample) of each soil sample as follows: $Msample\ (Percent) = \frac{(Wet\ Weight - Dry\ Weight)}{Dry\ Weight}\ X\ 100$ 4. Determine the oven-dry moisture of each test site (Msite), in pounds per cubic foot, as follows: $Msite = \frac{Msample\ x\ Dgauge}{(Msample+100)}$ Where: Msite= site moisture, pcf Msample = moisture content, Percent of dry weight (step 3) Dgauge = gauge measured wet density, pcf (from step 1) 5. Determine the correction factor (gauge moisture bias) to be applied to the gauge moisture readings. $Mbias(pcf) = Msite - Mgauge$ The average of the two bias values is the gauge moisture bias. This value can be used for all field testing of that project with that gauge for that same soil type.

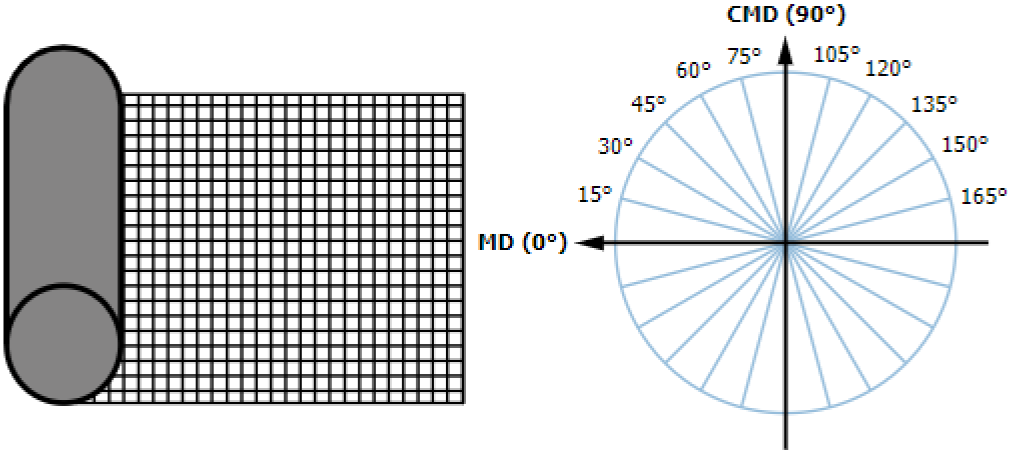
Section 11	*Report* The following data must be recorded on all project data sheets: • Reference site block data • Standard block data, including the density standard and moisture standard • Density count, moisture counts or contact, and air gap counts • Total wet density or bulk density • Dry density or bulk density dry • Moisture # and moisture percent • Proctor number and target number • Pit number, grading area, soils classifications, elevation • Percent compaction • Nuclear gauge manufacturer name and serial number • Station, elevation, and offset • Upper or lower zone • Operators name • Moisture bias noted in test remarks
A1	*Remove Annex A1 – Wet Density Calibration and Verification*
A2	*Remove Annex A2 – Water Content Calibration and Verification*
A3	*Remove Annex A3 – Gauge Count Precision*

WTM D6637

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow ASTM D6337 ***Standard Method of Test for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method*** with the following modifications:

ASTM D6637-15 Section	**WisDOT Modification:**
1.2	*Replace Section 1.2 with the following:* Tensile strength is determined by testing multiple geogrid ribs in tension (kN/m or lbf/ft)
1.2.1	*Remove Section 1.2.1 - Method A*
1.2.2	*Remove Section 1.2.2 – Method B*
1.2.3	*Remove Section 1.2.1 – Method C*
4.1	*Replace Section 4.1 with the following:* A relatively wide specimen is gripped across its entire width in the clamps of a constant rate of extension type tensile testing machine operated at a prescribed rate of extension, applying a uniaxial load to the specimen until the specimen ruptures. Tensile strength (kN/m or lbf/ft), elongation, and secant modulus of the test specimen can be calculated from machine scales, dials, recording charts, or an interfaced computer.
4.2	*Remove Section 4.2*
4.3	*Remove Section 4.3*
8.1	*Replace Section 8.1 with the following:* The specimens shall consist of at least 12 in. (300mm) in length, in order to establish a minimum specimen length in the direction of the test. The direction of the test shall be defined as either the machine direction (MD), cross-machine direction (CMD), or a nominal skewed angle referenced from the machine direction, according to Fig. 1 below, where MD and CMD are defined as 0° and 90°, respectively. All specimens should be free of surface defects, etc., not typical of the laboratory sample. Take no specimens nearer the selvage edge along the geogrid than 1⁄10 the width of the sample. FIG. 1 Specimen Orientation and Test Direction

	
8.2.1	*Remove Section 8.2.1 – Method A*
Note 2	*Remove Note 2*
Fig. 2	*Remove Fig. 2*
8.2.3	*Remove Section 8.2.3*
8.2.4	*Replace Section 8.2.4 with the following:* The outermost ribs are commonly cut prior to testing to permit extra width of material in the clamps to minimize slippage within the clamps. If this procedure causes nonuniform distribution of load to the gauge length area of the specimen, the same width of material shall be included in the clamps as will be tested in the gauge length area. In either case, the test results shall be based on the unit of width associated with the number of intact ribs.
8.3.1	*Replace Section 8.3.1 with the following:* Three test specimens are made in both the MD and CMD, for a total of 6 specimens used in the test. Specimens are cut from representative locations throughout the sample.
8.3.2	*Remove Section 8.3.2*
8.3.3	*Remove Section 8.3.3*
11.1	*Remove Section 11.1*
11.2	*Remove Section 11.2*
Note 6	*Remove Note 6*

12.1	*Remove Section 12.1 including all subsections (12.1.1 through 12.1.10)*
12.2	*Replace Section 12.2 with the following:* Report that the specimens were tested as directed in this test method, or any deviations from this test method. Describe all materials or products sampled and the method of sampling for each material.
12.2.1	*Replace Section 12.2.1 with the following:* Report all of the following applicable items for the machine direction and the cross machine direction of all materials tested:

WisDOT Test Procedure (WTP) S-001

Effective with January 2025 Letting
Revised Date: 12/02/2024

WisDOT Test Procedure for Field Determination of Moisture-Density Relationship of Gravely Soils

This procedure is for determining the relationship between the moisture content and density of soils containing appreciable quantities of R-4.75 mm (No. 4) material.

Section	WisDOT Procedure:
1.	***Apparatus***
1.1	• Molds and Detachable Base Plate: Standard 4-inch molds having a capacity of 1/30 cu. ft. and base plate. The molds may not be the split type. • Rammer: A rammer of 2-inch diameter having a flat circular face and weighing 5.5 lbs. The rammer must be equipped with a suitable arrangement to control the height of drop to a free fall of 12-inch above the elevation of the soil. • Sample Extruder (Optional): Not needed with split molds. • Balances: A balance or scale of at least 25 lbs. capacity sensitive to 4.5 g (0.01 lbs.), and a balance of at least 1,000 g capacity sensitive to 0.1 g, or other suitable scales or balances. • Drying Equipment: An oven, hot plate, stove, or other device for heating and drying the sample uniformly and as rapidly as possible without damaging the material. The drying pan should be large enough to allow manipulation of material without spilling. • Straightedge: A steel straightedge 12 inches in length and having one beveled edge. • Sieves: Standard 8-inch diameter sieves. Sizes 50 mm (2-inch), 19.0 mm (3/4-inch) and 4.75 mm (No. 4). • Mixing Tools: Miscellaneous tools such as mixing pan, spoon, trowel, spatula, knife, etc.
2.	***Sample Requirements***
2.1	If the soil sample is damp when received from the field, dry it until enough moisture has been lost so that it becomes friable under a trowel. Drying may be in air or by heating, but the temperature of the sample should not exceed about 60ºC (140ºF). Then thoroughly break up the aggregations in such a manner as to avoid reducing the natural size of individual particles.
2.2	Select a representative portion of the sample, completely dry it and determine the percentage retained on the 4.75 mm (No. 4) sieve. This value will be needed for comparison with the amount of R-4.75 mm (No. 4) material present in field density tests.

2.3	Select a representative sample, weighing approximately 14 lbs., or more, of the soil prepared as described in Step 1 above. Sieve it over the 50 mm (2-inch) and 19.0 mm (3/4-inch) sieves. Discard the coarse material retained on the 50 mm (2-inch) sieve. Weigh the material passing the 50 mm (2-inch) sieve and retained on the 19.0 mm (3/4-inch) sieve and replace it with an equal weight of material passing the 19.0 mm (3/4-inch) sieve and retained on the 4.75 mm (No. 4) sieve. Take the material for replacement from the remaining portion of the sample.
3.	***Procedure***
3.1	Thoroughly mix the selected representative sample with sufficient water to dampen it to a moisture content that is sufficiently below the optimum moisture content to form an adequate relationship to succeeding points.
3.2	Form a specimen by compacting the prepared soil in the 101 mm (4-inch) mold (with collar attached) in three equal layers to give a total compacted depth of about 127 mm (5-inches). Compact each layer by 25 uniformly distributed blows from the rammer, dropping free from a height of 305 mm (12-inches) above the elevation of the soil. During compaction, the mold must rest on a uniform, rigid foundation. Following compaction, remove the extension collar and carefully trim the compacted soil even with the top of the mold by means of the straightedge. Holes developed in the surface by removal of coarse material must be patched with smaller size material. Weigh the mold and moist soil. Multiply the weight of the compacted specimen and mold, minus the weight of the mold, by 1060, and record the result as the wet density in kilograms per cubic meters (or by 30 and record the wet density as pounds per cubic foot of compacted soil).
3.3	Remove the material from the mold and slice vertically through the center. Take a representative sample of the material from one of the cut faces, weigh immediately, dry to constant weight and determine the moisture content. The moisture content sample must weigh not less than 500 g.
3.4	Thoroughly break up the remainder of the material until it will pass a 19.0 mm (3/4-inch) sieve and 90% of the soil aggregations will pass a 4.75 mm (No. 4) sieve, as judged by the eye. Add water in sufficient amounts to increase the moisture content of the soil sample by one or two percentage points and repeat the above compaction and moisture determination procedures. Continue this series of determinations until there is either a decrease or no change in the wet weight per cubic meter or per cubic foot of the compacted soil.
3.5	This procedure has been found acceptable in most cases. However, in instances where the soil material is fragile in character and will reduce significantly in grain size due to repeated compaction, and in cases where the soil is a heavy textured clayey material into which it is difficult to incorporate water, a separate and new sample must be used in each compaction test. In these cases, separate samples must be thoroughly mixed with amounts of water sufficient to cause the moisture contents of the samples to vary by approximately two percentage

points. The moisture contents selected must bracket the optimum moisture content, thus providing samples which, when compacted, will increase in weight to the maximum density and then decrease in weight. The samples of soil-water mixtures must be placed in covered containers and allowed to stand for not less than 12 hours before making the moisture-density test. This soaking allows time for uniform dispersion of the moisture throughout the sample before compaction.

4. *Calculations*

4.1 Calculate the moisture content and the dry weight of the soil as compacted for each trial, as follows:

$$W = \frac{W_1}{w + 100} X\,100$$

$$w = A - \frac{B}{B - C} X\,100$$

Where:

w =percentage of moisture in the specimen, based on oven-dry weight of soil

A =weight of container and wet soil

B =weight of container and dry soil

C =weight of container

W =dry weight, in pounds per cubic foot of compacted soil

W_1 =wet weight, in pounds per cubic foot of compacted soil

5. *Report*

5.1 **Plotting Moisture-Density Relationship**

The calculations in section 4.1 must be made to determine the moisture content and corresponding oven-dry weight per cubic foot (density) for each of the compacted soil samples. The densities of the soil must be plotted as ordinates (y axis) and corresponding moisture contents as abscissas (x axis).

Optimum Moisture Content

When the densities and corresponding moisture contents for the soil have been determined and plotted, it will be found that by connecting the plotted points with a smooth line, a curve is produced. The moisture content corresponding to the peak of the curve is termed the "optimum moisture content" of the soil under the above compaction.

Maximum Density

The oven-dry weight per cubic foot of the soil at optimum moisture content is termed "maximum density" under the above compaction.

	Report maximum density and optimum moisture content.

Back to Top SOILS

WTM R30

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO R30 ***Standard Practice for Mixture Conditioning of Hot Mix Asphalt (HMA)*** with the following modifications:

<table>
<tr><th>AASHTO R30-02 (2019) Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><p>Remove the following reference:</p><p>AASHTO PP 3 – Preparing Hot Mix Asphalt Specimens by Means of the Rolling Wheel Compactor</p><p>Replace the AASHTO T312 reference with the following WisDOT Modified version:</p><p>WTM T312 – Superpave Gyratory Compactor</p></td></tr>
<tr><td>3.</td><td><p>Replace Section 3 – Summary of Practice</p><p>For mixture conditioning for volumetric mixture design, a mixture of aggregate and binder is conditioned in a forced-draft oven for 2 h at the mixture’s specified temperature.</p><p>For aggregate JMF blends with moisture absorption greater than or equal to 2.0% a 4-hour cure time is used and indicated on the JMF mix design report. Report the actual absorption value on the report and additionally state the cure time within the report or comment section.</p><p>For short-term mixture conditioning for mechanical property testing, a mixture of aggregate and binder is conditioned in a forced-draft oven for 4 h at 135 ± 3°C (275 ± 5°F). For long-term mixture conditioning for mechanical property testing, a mixture of aggregate and binder is conditioned in a forced-draft oven for 6 h at 135 ± 3°C (275 ± 5°F).</p>
<table>
<tr><th rowspan="2">Sample Type</th><th>Volumetric Testing</th><th colspan="2">Mechanical Property Testing</th></tr>
<tr><th>Mix Design Aging</th><th>Short Term Aging</th><th>Long Term Aging</th></tr>
<tr><td>Mix Design or
Laboratory-mixed and Laboratory-compacted (LMLC)</td><td>2 h – non absorptive
4 h - absorptive</td><td>4 h</td><td>6 h</td></tr>
<tr><td>Plant Produced* or
Plant-mixed and Laboratory-compacted (PMLC)</td><td>N/A</td><td>N/A</td><td>6 h</td></tr>
</table>
<p>*Follow WTM T312 for procedure to reheat a Plant Produced mixture sample.</p></td></tr>
</table>

7.1.2	*Replace Section 7.1.2 – Mixture Conditioning for Volumetric Mix Design* Place the mixture in a pan and spread it to an even thickness ranging between ¾ and 1 in. (19.0mm and 25.0mm). Place the mixture and condition according to the table in Section 3 above.
7.1.3	*Remove Section 7.1.3*
7.1.4	*Add the following to Section 7.1.4:* For aggregate JMF blends with moisture absorption greater than or equal to 2.0% a 4-hour cure time is used and indicated on the JMF mix design report. Report the actual absorption value on the report and additionally state the cure time within the report or comment section.
7.2.2	*Replace Section 7.2.2 – Short-Term Conditioning for Mixture Mechanical Property Testing with the following:* Place the loose mixture in a pan or pans, and spread it to an even thickness ranging between ¾ in. – 1 in. thick (19.0mm and 25.0mm). Place the mixture and pan in the preheated conditioning oven for 4 h ± 5 m in at a temperature of 135 ± 3°C (275 ± 5°F).
7.2.3	*Remove Section 7.2.3*
7.3.1	*Replace Section 7.3.1 – Long Term Conditioning for Mixture Mechanical Property with the following:* The long-term conditioning for the mixture mechanical property testing procedure applies to laboratory-prepared mixtures that have been subjected to the short-term conditioning for the mixture mechanical property testing procedure described in Section 7.2, and plant-mixed HMA. All long-term conditioning for WisDOT mixture mechanical property testing will be completed on loose HMA. For long-term conditioning of loose mix: Place the loose mixture in a pan or pans, and spread it to an even thickness ranging between ¾ in. - 1 in. thick (19.0mm and 25.0mm). Place the mixture and pan in the preheated conditioning oven for 6 h +/- 5 min at a temperature of 135 ± 3°C (275 ± 5°F). If the compaction temperature of the mix is less than 138°C (280°F) proceed directly to compaction according to WTM T312. Otherwise, heat the mixture to compaction temperature before compaction according to WTM T312. After compaction cool each specimen to room temperature before testing by placing in front of a fan for a minimum of 2 h or at room temperature for a minimum of 16 h.
7.3.2 - 7.3.6	*Remove sections 7.3.2 through 7.3.6*
8.	*Remove Section 8. - Report*

WTM R35

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO R35 ***Standard Practice for Superpave Volumetric Design for Asphalt Mixtures*** with the following modifications:

AASHTO R35-17 (2021) Section	**WisDOT Modification:**
2.1	*Remove the following references:* AASHTO R83 – Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC) AASHTO T275 – Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Paraffin-Coated Specimens *Replace the AASHTO R30, R90, R76, T11, T27, T84, T85, T166, T209, T283 and T312 references with the following WisDOT Modified versions:* WTM R30 – Mixture Conditioning of HMA WTM R90 – Sampling of Aggregate WTM R76 – Reducing Samples of Aggregate WTM T11 – Finer than No. 200 WTM T27 – Sieve Analysis WTM T84 – Fine Aggregate Specific Gravity WTM T85 – Coarse Aggregate Specific Gravity WTM T166 – Bulk Mix Gravity (Gmb) WTM T209 – Theoretical Mix Gravity (Gmm) WTM T283 – Tensile Strength Ratio (TSR) WTM T312 – Superpave Gyratory Compactor *Replace AASHTO M320 with the following WisDOT Modified versions:* WTM M332 – Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test *Add the following references:* WTM T304 – Fine Aggregate Angularity WTM D8159 – Automatic Extraction AASHTO T305 – Draindown Characteristics
3.14	*Delete Section 3.14*
3.15	*Delete Section 3.15*
3.16	*Delete Section 3.16*
3.17	*Delete Section 3.17*
4.1	*Replace Section 4.1 with the following:* *Materials Selection*

	Binder, aggregate and RAM stockpiles are selected that meet the environmental and traffic requirement applicable to the paving project. The bulk specific gravity of all aggregates proposed for blending and the specific gravity of the binder are determined. Select an asphalt binder meeting the contract requirements and having been defined or graded according to AASHTO M332 and the department's Combined State Binder Group Method of Acceptance for Asphalt Binders available at: https://engineering.purdue.edu/~csbg/method.html The asphalt binder source and grade indicated on the JMF Mix Design report must represent the material used during the mix design process in determining the optimum asphalt content. If recycled asphaltic materials are part of the mix design, ensure the design meets the requirements for recycled asphaltic materials and recovered asphaltic binders in the WisDOT Standard Specification.
Note 4	*Replace Note 4 with the following:* Use 2.500 for the RAS Gsb. To determine RAP Gsb, extract aggregate from RAP using one of the following procedures: • Chemical extraction according to AASHTO T164 method A or B • Automated extraction according to WTM D8159 • Ignition oven according to WTM T308 Then determine the combined RAP specific gravity of the extracted coarse and fine aggregates according to WTM T84 and WTM T85.
4.2	*Replace Section 4.2 with the following:* *Design Aggregate Structure* It is recommended that at least three trial aggregate blend gradations from selected aggregate stockpiles are blended, however this is optional. For each trial gradation, an initial binder content is determined, and at least two specimens are compacted in accordance with WTM T 312. A design aggregate structure and estimated design binder content are selected on the basis of satisfactory conformance of a trial gradation meeting the requirements in the WisDOT Standard Specification.
4.3	*Replace Section 4.3 with the following:* *Design Binder Content Selection* Replicate specimens are compacted in accordance with WTM T312 using a minimum of 3, preferably 4 binder contents (0.5% increments). The design binder content is selected on the basis of satisfactory conformance with the requirements of the WisDOT Standard Specification. All new mix designs, except SMA, need at least one point that is a minimum of 0.5% below 3.0% Air Voids (≤ 2.5% Va) and one point that is at least 0.5% above 4.0% Air Voids (≥ 4.5% Va).

	Compare trial binder content results. Select an optimum design binder content (by either graphing or interpolating the trial data results) meeting requirements in the WisDOT Standard Specification. Validate compliance of %Gmm at Nmax and Nini by compacting 2 specimens at the design binder content to Nmax gyrations.
4.4	*Replace Section 4.4 with the following:* *Evaluating Moisture Susceptibility* Evaluate the moisture susceptibility of the design aggregate structure at the asphalt binder content corresponding to 3.0% air void regressed design, or 4.5% air void design for SMA. Moisture Susceptibility, indicated by the tensile strength ratio (TSR), which is determined using WTM T283.
4.5	*Add Section 4.5 with the following:* *Evaluating Draindown* –For SMA designs, AASHTO T305 must be followed.
4.6	*Add Section 4.6 with the following:* *Evaluating Fine Aggregate Angularity* – Fine aggregate angularity (FAA) is determined using WTM T304 by either of the following methods: *Weighted Average FAA method:* Perform WTM T304 on each individual component with more than 10% passing #8 sieve (2.36mm). Using the JMF blend percentages, mathematically combine each individual component using the following equation: $Mathematically\ Calculated\ \mathrm{FAA} = \left[A\left(\frac{a}{(a+b+c+\cdots n)}\right)\right] + \left[B\left(\frac{b}{(a+b+c+\cdots n)}\right)\right] + \left[C\left(\frac{c}{(a+b+c+\cdots n)}\right)\right] + \left[N\left(\frac{n}{(a+b+c+\cdots n)}\right)\right]$ *A, B, C ….N = FAA value for corresponding component aggregate* *a, b, c ….n = Blend percentage for corresponding component aggregate* PLEASE NOTE: It is suggested to check the weighted Average FAA when making blend changes in the field. *Extracted Blend FAA method:* Perform WTM T304 on extracted design or production material. Acceptable extraction methods are WTM D8159 or AASHTO T164 Method A or B. PLEASE NOTE: The Extracted Blend FAA method will be used for verification of the mix design.
6.8	*Replace the first sentence of Section 6.8 with the following:*

	It is optional to prepare a minimum of three trial aggregate blend gradations; plot the gradation of each trial on a 0.45-power gradation analysis chart, to confirm that each trial blend meets M 323 gradations controls (see Table 4 of M 323).
8.1	*Replace Section 8.1 with the following:* It is optional to prepare replicated mixtures (Note 8) at the initial trial binder content of each of the chosen trial aggregate trial blend gradations. From WisDOT Standard Specification determine the number of gyrations based on the design mix type for the project.
Note 9	*Remove Note 9*
Table 1	*Replace Table 1 with WisDOT Standard Specifications*
Note 10	*Remove Note 10*
Note 11	*Remove Note 11*
Note 12	*Replace Note 12 with the following:* The maximum specific gravity for each trial mixture shall be based on the average of at least 2 tests. A minimum of two tests must be run, one each at two different asphalt trial binder contents. Calculate the Gse for each Gmm test run (to three decimal places, 0.001) and average the results. Use this calculated average Gse to determine all Gmm values for the trial data. Report any Gmm value to three decimal places (0.001).
9.1	*Replace section 9.1 with the following:* Determine the volumetric requirements for the trial and design mixtures in accordance with WisDOT Standard Specifications.
9.2	*Replace Section 9.2 with the following:* Calculate Va and VMA at Ndesign for each trial mixture, mix design and production sample using Equations 2 and 3: $Va = 100\left(1-\left(\frac{Gmb}{Gmm}\right)\right)$ *(2)* $VMA = 100 - \frac{Gmb\ x\ (100-Pb)}{Gsb}$ *(3)* where: *Gmb* = bulk specific gravity of extruded specimen *Gmm* = theoretical maximum specific gravity of the mixture *Gsb* = bulk specific gravity of the combined aggregate *Pb* = Percent Binder (asphalt content (AC))
11.	*Replace the entire Section 11 with the following:* *Evaluating Moisture Susceptibility* – Follow WTM T283
13.4	*Add Section 13.4* ***Report*** *with the following:*

The mix designer/laboratory creates a summary report to be submitted electronically into Atwood's Systems using the 249 form for review, along with an electronic copy (pdf of the 249 form and mix design report) to BTS and the regional office. This summary must include trial data used to determine the design optimum binder content.

The following is a breakdown of the minimal information needed to be listed on the mix design report.

Summary of Aggregate Source/Component and RAM Data:

- Source name (as noted on 225 report), pit or quarry designation (P or Q), and 225 number, for each component, using the following format (225-xxxx-xxxx).
- Component Gradations: gradations for each aggregate and the final blend must be shown as the percent passing (the nearest 0.1) for the 1 ½ in. (37.5mm), 1 in. (25.0mm), ¾ in. (19.0mm), ½ in. (12.5mm), ⅜ in. (9.5mm),#4 (4.75mm), #8 (2.36mm), #16 (1.18mm), #30(0.60mm), #50(0.30mm), #100(0.150mm), and#200(0.075mm) sieves.
- The percent of each aggregate and RAM component as compared to the total aggregate.
- LA Wear loss, percent (include department test number or listed values).
- Soundness loss, percent (include department test number or listed values).
- Freeze-thaw, percent (include department test number or listed values, refer standard spec 106.3.4.2.2).
- Aggregate Bulk specific gravity (Gsb).
    - For mixtures containing RAM extracted gradation data, Gsb and percent extracted asphalt content is required.
- Flat and elongated (Method B), percent.
- Coarse fracture/crush count (1-face and 2-face), percent.
- Fine aggregate angularity (Method A) for fine aggregate only. i.e.: Sands (Natural, Manufactured) and P#8 of RAM components.
- Moisture absorption, percent.

Aggregate Blend Data:

- Flat and elongated (Method B), percent.
- Coarse fracture/crush count, percent.
- Sand equivalency.
- Fine aggregate angularity.
- Moisture absorption percent.
- Bulk specific gravity (Gsb).
- Effective specific gravity (Gse).

Asphaltic Binder:

- Binder source (supplier).
- Binder performance grade and designation level (S, H, V, or E).
- Binder specific gravity @ 77 / 77F (25 / 25C).
- Laboratory Mixing Temperature, Production Temperature, and Laboratory Compaction Temperatures .

- Type of Additive
- Amount of Additive

Mixture Properties (using trial asphalt binder contents)

- Binder content, percent (Pb).
- Air Voids, percent (Va).
- Maximum specific gravity (Gmm).
- Bulk specific gravity of the compacted mixture (Gmb).
- VMA (voids of the mineral aggregate), percent.
- VFB (voids filled with binder) also called VFA (voids filled with asphalt), percent.

Mixture Properties (design "optimum" asphalt binder content):

- Binder content, percent (Pb).
- Maximum specific gravity (Gmm).
- Bulk specific gravity (Gmb).
- Air voids, percent (Va).
- VMA (voids of the mineral aggregate), percent.
- VFB (voids filled with binder), percent.
- DP (dust/binder proportion), percent (using effective binder content, Pbe, for calculation).
- Gyratory compaction effort (for Nini, Ndes and Nmax).
- %Gmm (for Nini, Ndes and Nmax).
- Gmm Dryback Correction Factor, percent (if applicable).

Mixture Properties (3.0% "Air-Void Regression" asphalt binder content):

- Binder content, percent (Pb).
- Maximum specific gravity (Gmm).
- Bulk specific gravity (Gmb).
- Air voids, percent (Va).
- VMA (voids of the mineral aggregate), percent.
- VFB (voids filled with binder) also called VFA (voids filled with asphalt), percent.
- TSR (tensile strength ratio).
- TSR Compaction Effort (N = "x").

For Recycled Asphaltic Pavement Mixtures, also list:

- Added binder content, percent.
- Total binder content, percent.
- Extracted asphalt binder percent (of recycled components)
- Percent Binder Replacement (Pbr)

Miscellaneous:

- Name of WisDOT - HTCP Certified HMA technician (at level designated for mix design) identifying responsibility for mix design data.
- Name of design laboratory facility, its address and phone number (contact location).

	• Design date (representing completion of the mix design work). • Design ID (unique number or name). • Traffic level classification (e.g. LT, MT, HT). • Asphalt mixture gradation (NMAS) (e.g., Gradation 1, 2, 3, 4, 5 or 6 representing 37.5mm to 4.75mm, respectively). • For SMA, report draindown results (at two temperatures)
X2	*Remove Section X2*

WTM R47

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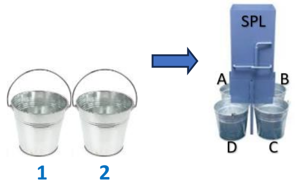
Follow AASHTO R47 ***Standard Practice for Reducing Samples of HMA to Testing Size*** with the following modifications:

AASHTO R47-19 Section	WisDOT Modification:
2.1	*Replace the AASHTO R97 reference with the following WisDOT Modified version:* WTM R97 – Sampling HMA Mixtures
7.1	*Add the following to Section 7.1 – Mechanical Splitter Type A (Quartermaster^{TM})* Other devices to assist in the sampling and quartering procedures may be used with department approval. The Quartermaster™ is one such device.
7.2	*Remove Section 7.2 – Apparatus: Mechanical Splitter Type B (Riffle Splitter)*
8.2	*Replace Section 8.2 – Two-Part Splitting of HMA Samples using the Quartermaster^{TM}, with the following:* 1. Dump initial truck box samples into the machine, noting the chute capacity. 2. Throw lever to allow material to flow into the four quartering buckets. Repeat until all material has been quartered. 3. Make sure to distribute any clinging fines into each bucket. Combine diagonally opposite buckets to form the test sample (A+C) and the retained (B+D).. 4. From this point, remove the QC test material to a heated splitting table for further reduction to testing portions. Bag the retained sample, label and store appropriately. 5. Clean sides and quartering slats before next use.
8.2.1	*Add Section 8.2.1 – Four-Part Splitting (formerly Three-Part Splitting) of HMA Samples using the Quartermaster^{TM}, with the following:* When using a Quartermaster for a four-part split, it is required to collect "four times" the minimum split-sample (e.g. for No. 4, 12.5mm HMA, 4 x 35 is= 140lbs). The Quartermaster is used to split the asphalt mixture to minimize any segregation during the splitting process. The image below illustrates the steps used to ensure uniform splits for each party and should be followed each time the Quartermaster device is used for a four-part split sample. The fourth quadrant of material ("extra") can only be used as an additional sample when Gmm or Gmb replicate tolerances are not met. If it is not needed, it may be discarded.

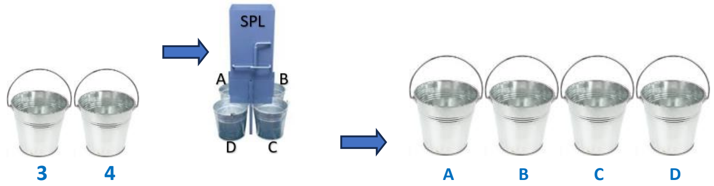
FIGURE 6 Four-Part Split Sample Using Quartermaster Device (140 lbs.)

Step 1: **Grab 4 buckets of loose mix from the truck (if using a department approved mechanical sampling device & increased capacity hopper, place the minimum material sample weight requirement in the hopper and skip to step 3):**

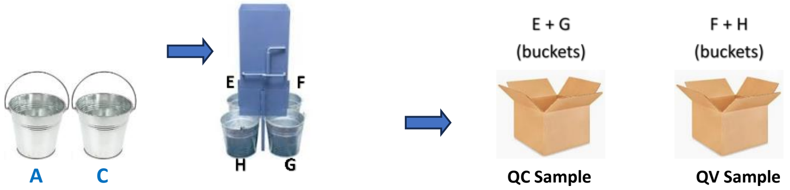
Step 2: **a) Combine & split buckets 1 & 2 <u>to fill half</u> of buckets A, B, C & D.**



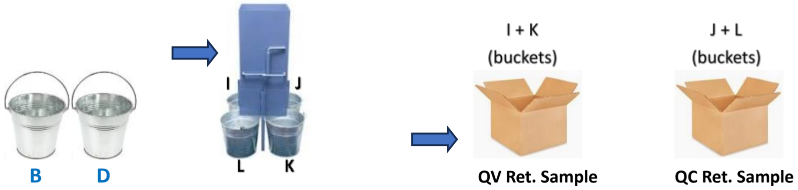
b) Then combine & split buckets 3 & 4 <u>to fill remaining half</u> of buckets A, B, C & D.



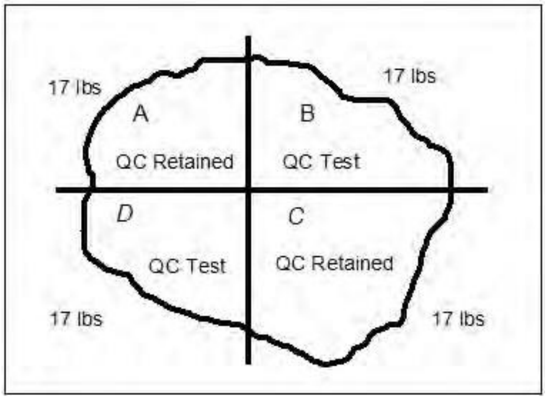
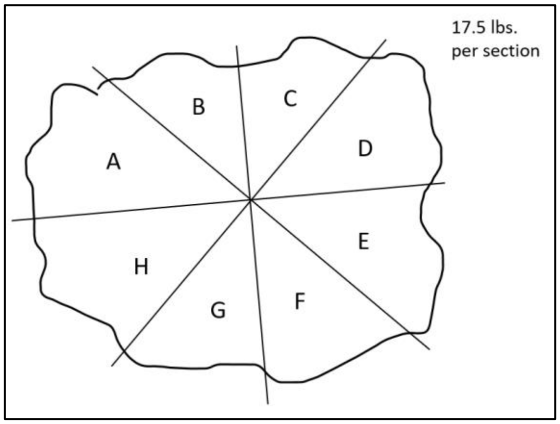
Step 3: **Recombine & split opposite corner buckets <u>A & C</u> Then recombine opposite bucket corners (E & G, F & H) to yield first two box samples.**



Step 4: **Recombine & split opposite corner buckets <u>B & D</u> Then recombine opposite bucket corners (I & K, J & L) to yield remaining two box samples.**



8.3	*Remove Section 8.3 – Procedure for Mechanical Splitter Type B (Riffle Splitter)*
10.3	*Replace Section 10.3 with the following:* Divide the flattened mass into quarters (for the splits defined in Sections 10.5 or 10.6 below) by inserting a quartering template or straightedge and pressing down until the template is in complete contact with the surface of which the sample is placed.

10.5	*Add Section 10.5 – Two-Part Quartering Method Using Quartering Technique, with the following:* For the two-part quartering process, you need to collect “two times” the minimum split-sample size found in the WTM R97. Quarter the Test & Retained samples as shown in the figure below. The figure below is an example for No. 4 (12.5mm) mixes start with at least a total of 70 lbs of HMA.  Diagonal quarters, as indicated on the sketch, must be combined to form the retained sample (A + C) and the test sample (B + D). The retained sample must be boxed, labeled in accordance with WTM R97, and stored in a protected, safe, dry place.
10.6	*Add Section 10.6 – Four-Part Quartering (formerly Three-Part Quartering) Method Using Quartering Technique, with the following:* For the four-part quartering process, you need to collect “four times” the minimum split-sample size found in the WTM R97. Split the sample into a QC test, QV test, Retained, and Extra Samples as shown below. The fourth quadrant of material (“Extra”) is intended to be used as an additional sample when Gmm or Gmb replicate tolerances are not met. If it is need not needed, it may be discarded. The figure below is an example for No. 4 mixes (12.5mm) which require at least a 140 lbs of HMA (e.g. 4-times 35lbs).  For a four-part split shown in figure above, the opposite diagonal sections, as indicated on the sketch, must be combined: to form the QV sample (A+E), Retained sample (B+F), the QC sample (C+G), and the Extra Sample (D+H). The retained sample

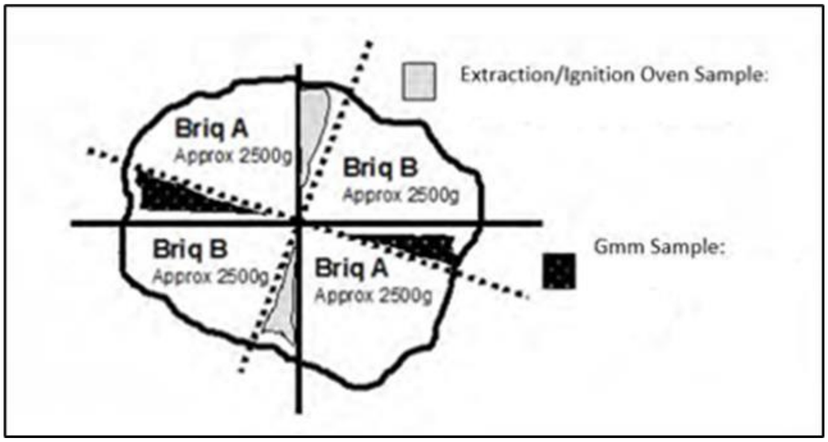
must be boxed and labeled in accordance with WTM R97, and stored in a protected, safe, and dry place.

11. *Remove the entire Section 11. – Apparatus for Incremental Method*

12. *Remove the entire Section 12. – Procedure for Incremental Method*

14. *Add Section 14. – Further Reduction of HMA to Testing Size with the following:*

The individual HMA material for testing acquired from either a two-part or four-part splitting procedure is further reduced for testing. The figure below shows an example of the approximate breakdown of a No. 4 (12.5mm) HMA mixture (35 lbs). The table below shows the appropriate HMA testing sizes.



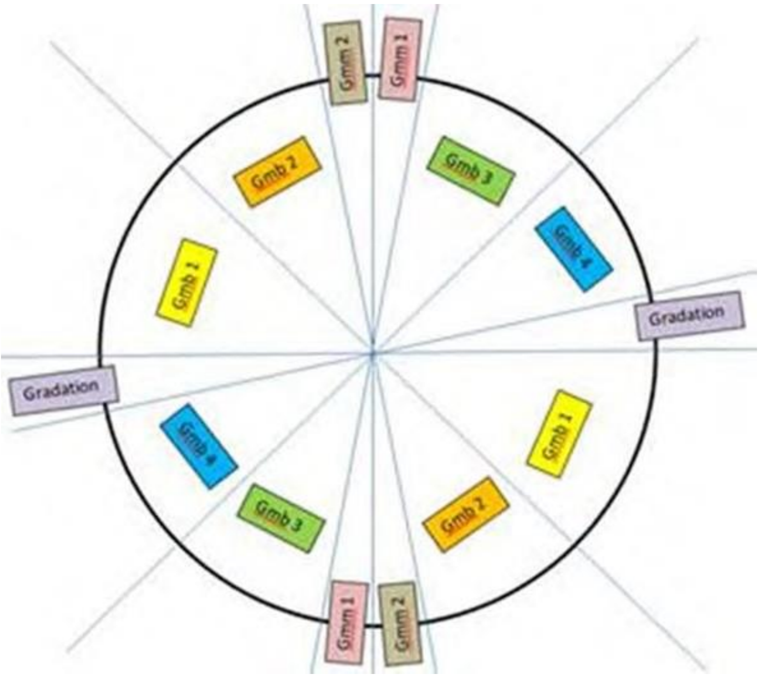
Minimum HMA and SMA Testing Sample Sizes			
Gmm (RICE) Sample Size		Extraction/Ignition Oven Sample Size	
Mixture NMAS	Sample Size (g)	Mixture NMAS	Sample Size (g)
37.5mm (No. 1)	4,000	37.5mm (No. 1)	4,000
25.0mm (No. 2)	3,000	25.0mm (No. 2)	3,000
19.0mm (No. 3)	2,000	19.0mm (No. 3)	2,000
12.5mm (No. 4)	1,500	12.5mm (No. 4)	1,500
9.5mm (No. 5)	1,000	9.5mm (No. 5)	1,200
4.75mm (No. 6)	1,000	4.75mm (No. 6)	1,200

14.1 *Add Section 14.1 – Further Reduction of SMA Samples to Test Sizes*

For this example, the approximate 70 lbs of SMA material is further reduced for testing according to the figure below. As shown in the figure below, combine opposite diagonal sections to yield the following:

- Four Gmb specimens
- Two Gmm specimens
- One Extraction/Gradation specimen

SMA Sample (Laboratory Split of approx. 70 lbs):



WTM R67

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO R67 ***Standard Practice for Sampling Asphalt Mixtures after Compaction (Obtaining Cores)*** with the following modifications:

AASHTO R67-20 Section	**WisDOT Modification:**
1.1	*Replace Section 1.1 with the following:* This method describes the process for removal of a core sample of compacted asphalt mixture from a pavement for laboratory testing. Core diameter is either 4 inches or 6 inches.
4.3	*Replace Section 4.3 with the following:* *Separation Equipment* – A saw that provides a clean, smooth plane representing the layer to be tested without damaging the specimen.
4.7	*Replace Section 4.7 with the following:* *Package Containers* – Suitable packaging containers for securing and transporting the core samples are cylinder molds.
5.1 & Note 2	*Replace Section 5.1 with the following:* Freshly compacted asphalt mixtures shall be allowed sufficient time to cool prior to coring in order to prevent damage to the core. Cores are cut under department/project staff observation. **Note 2** – To accelerate the coring process, compacted asphalt mixtures may be cooled to expedite the removal of the core by the following methods: water, ice, dry ice, or liquid nitrogen.
5.7	*Replace Section 5.7 with the following:* Clearly label the core with a sample marking tool. Relabel each core immediately after extracting or ensure that labels applied to pavement prior to cutting remain legible. The layer interface should also be marked immediately following extracting. Label cores according to Section 8 below.
5.8	*Replace Section 5.8 with the following:* Fill all core holes with non-shrink rapid-hardening grout, mortar, or concrete, or with HMA. When using grout, mortar, or concrete, remove all water from the core holes prior to filling. Mix the mortar or concrete in a separate container prior to placement in the hole. If HMA is used, fill all core holes with hot-mix matching the same day's production mix type at same day compaction temperature +/- 20 F. The core holes shall be dry and coated with tack before filling, filled with a top layer no thicker than 2.25 inches, lower layers not to exceed 4 inches, and compacted with a Marshall hammer or similar tamping device using approximately 50 blows per layer. The

<table>
<tr><td></td><td>finished surface shall be flush with the pavement surface. Any deviation in the surface of the filled core holes greater than 1/4 inch at the time of final inspection will require removal of the fill material to the depth of the layer thickness and replacement.</td></tr>
<tr><td>6.1 & Note 5</td><td><i>Replace Section 6.1 and Note 5 with the following:</i>
Package core samples in suitable protective containers. 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 transported in a cooler with ice. Avoid any stacking of pavement cores.
Note 5: Concrete cylinder molds work well to transport cores.</td></tr>
<tr><td>6.2</td><td><i>Replace Section 6.2 with the following:</i>
Transport cores in a manner that prevents damage from jarring, rolling, or impact with any object. Cores should be protected from excessive temperatures such as direct sunlight.</td></tr>
<tr><td>7.1</td><td><i>Replace Section 7.1 with the following:</i>
Using appropriate separation equipment, separate two or more pavement cores, lifts, or layers along the designated lift line. Cores should be cut to allow for density measurement of only the most recently placed layer.</td></tr>
<tr><td>8</td><td><i>Replace the entirety of Section 8 with the following:</i>
For test strips, each core should be labeled with the following:
<table>
<tr><td>Direction</td><td>N - Northbound
E – Eastbound
S – Southbound
W – Westbound</td></tr>
<tr><td>Lane</td><td>1 – Lane 1
2 – Lane 2, etc…</td></tr>
<tr><td>Layer</td><td>U – Upper Layer
L – Lower Layer</td></tr>
<tr><td>Lot</td><td>1 – Lot 1, etc…</td></tr>
<tr><td>Sublot</td><td>4 – Sublot 4, etc…</td></tr>
</table>
For example: “E1-L-1-4” stands for Eastbound, Lane 1, Lower Layer, Core Number 1-4
For dispute resolution, label the core with a “D” at the end. For example: “E1-L-1-4-D”.</td></tr>
</table>

WTM R79

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO R79 ***Standard Practice for Vacuum Drying Compacted Asphalt Specimens*** with the following modifications:

AASHTO R79-22 Section	**WisDOT Modification:**
5.1	*Replace Section 5.1 with the following:* Specimens shall be kept and stored at temperatures 15 – 30°C (60 - 85°F).
5.4	*Replace Section 5.4 with the following:* Measure the sample temperature. Make sure the specimen surface temperature is between 15 – 30°C (60 - 85°F).

WTM R97

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Follow AASHTO R97 ***Standard Practice for Sampling Asphalt Mixtures*** with the following modifications:

AASHTO T97-19 Section	**WisDOT Modification:**
4.2	*Add the following to Section 4.2 – Mechanical Sampling Systems:* A clam-shell sampler is an example of a mechanical probing device approved by the department. This can be used in lieu of a Technician physically entering the truck box, yet technician must be appropriately certified.
4.3	*Add the following to Section 4.3 – Shovels or Metal Scoops:* The shovel is to be of such size and configuration that each increment of a sample can be obtained in one attempt without spilling or roll off. To satisfy this requirement with a flat bottom shovel, it is necessary to attach 2-4-inch vertical sides to the shovel.
4.4	*Remove Section 4.4 – Belt Template*
4.5	*Remove Section 4.5 – Sampling Plate*
4.6	*Remove Section 4.6 – Cookie Cutter Sampling Device*
5.2	*Add the following table to Section 5.2 – Sample Size:*

Mixture NMAS	Minimum Individual Sample Size	
	HMA	SMA
≤ ½ in. (12.5mm), No. 4-5	35 lbs	70 lbs
¾ in. – 1 in. (19.0mm - 25.0mm), No. 2-3	50 lbs	--
> 1 ½ in. (37.5mm), No. 1	80 lbs	--

The total amount of material collected from the truck for all mixtures will be enough to provide the required minimum testing and retained samples.

- For an individual sample size exceeding 50 lbs, the sample will be split into two separate boxes.
- For a two-part split sample, the amount of material collected will be at least twice the individual sample size shown above (e.g. for a No. 4 12.5mm HMA, 2 x 35 is 70 lbs), yielding "test" and "retained" portions for either QC or QV.
- For a four-part split sample, the total amount of material collected from the truck will be at least four times the individual sample size shown above.

5.4	*Remove the entire Section 5.4 - Sampling Using Attached Sampling Device*

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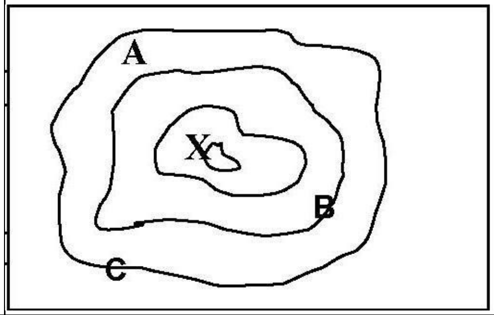
5.5	*Remove the entire Section: 5.5 – Sampling from Conveyor Belt Using a Sampling Template*
5.6.1 & 5.6.2	*Replace Sections 5.6.1 and 5.6.2 – Sampling from Transport Units with the following*: When the last batch has been dumped into the truck box, an HMA Tech certified at a level recognized for mixture sampling or production testing collects a sample from the truck box. The sampler must establish a reference point on the surface of the load, either at the high point, if a conical shape exists, or near the middle of the truck box if the surface shows no such conical shape. Then at least three incremental sample points (unless approved mechanical sampling device is capable of obtaining a representative minimum sample size in less than 3 locations) should be established about midway between the previously established point and the sides of the truck and equally spaced around the load as seen in the figure below. After removing the upper two to three inches of mix the sampling shovel or other approved device can be inserted into the underlying mixture to extract the sample increments. **Truck Box Sampling**  X - Reference Point A - Sample Point B - Sample Point C - Sample Point
5.7	*Remove the entire Section 5.7 - Sampling from a Paver Auger*
5.8	*Remove the entire Section 5.8 - Sampling from a Windrow*
5.9	*Remove the entire Section 5.9 - Sampling from Roadway before Compaction*
5.10	*Remove the entire Section 5.10 - Sampling from a Paver*
5.11	*Remove the entire Section 5.11 - Sampling from Stockpiles*
6.	*Replace the entire Section 6 with the following:* The contractor is responsible for sampling, splitting, and labeling samples. When a mixture sample is procured, it must be quartered according to WTM R47, and the retained portions placed in a box. The required box must have dimensions of 10 in. x 8 in. x 8 in. (such as Uline S- 19062). Each box must be labeled with a pre-printed blank label that includes the following fields that are to be filled out by the technician at the time of sampling: • Contractor, testing Lab. • Certified technician name and HTCP number. • Sample type: QC, QC-ret, QV, QV-ret.

	• State project ID. • Date. • Sample number. • Type of asphaltic mixture. • State mix design ID (250-XXXX-YR). • Percent binder from current JMF. • Daily tonnage sampled. • Cumulative tonnage. • Current Gsb. • For QV samples: the name, HTCP number, and company of the witness representing the department The cumulative/total tons representing mix design production are recorded on the QC data sheet (running average).

WTM T30

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T30 **Standard Method of Test for *Mechanical Analysis of Extracted Aggregate*** with the following modifications:

AASHTO T30-21 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R35, T255 and T308 references with the following WisDOT Modified versions:* WTM R35 – Superpave Volumetric Mix Design WTM T255 – Bulk Specific Gravity (Gmb) Using Vacuum Sealing WTM T308 – Ignition Oven *Add the following reference:* WTM D8159 – Automatic Extraction
6.1	*Replace Section 6.1 with the following:* The sample shall consist of the entire lot or representative sample of aggregate obtain according to AASHTO T164 Method A or B, or WTM T308 or WTM D8159 from which the binder material has been extracted.
Note 3	*Replace Note 3 with the following:* Samples obtained from AASHTO T164 Method A or B, WTM T308 or WTM D8159 should be dried to a constant mass as part of the procedures within those standards. If the procedures described herein are completed immediately following the procedures in any of those methods, it will not be necessary to dry the sample again. If more than 24 h pass between the completion of AASHTO T164 Method A or B, WTM T308 or WTM D8159 and the beginning of this test procedure , or if the sample is stored in a high-humidity environment, or has otherwise been subjected to moisture, the sample should be dried again.
7.1	*Replace Section 7.1 with the following:* Dry the sample, if necessary, to a constant mass using an oven at 110 ± 5°C (230 ± 9°F), measuring mass at 15 minute intervals until there is less than 0.1 percent mass loss. Determine and record the mass of the sample to the nearest 0.1 g.
7.2	*Replace section 7.2 with the following:* If testing a sample that was previously extracted using the WTM D8159 method, skip to Section 7.5. Otherwise, place the test sample in a container and cover it with water. If using a wetting agent, add sufficient amount to assure a thorough separation of the material finer than the 0.075mm (#200) sieve from the coarser particles (per Note 5). Agitate the contents of the container vigorously and immediately

	decant the wash water over a nest of two sieves consisting of a 2.0mm (#10) or 1.18mm (#16) sieve superimposed on a 0.075mm (#200) sieve (Note 6). The use of a large spoon or similar device is recommended to aid the process of agitating the contents of the container. Limit the agitation by mechanical washing to a limit of 10 minutes.
9.1	*Replace section 9.1 as follows:* Report the results of the sieve analysis as total percent passing each sieve, which shall be reported to the nearest 0.1 percent.

WTM T166

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T166 ***Standard Method of Test for Bulk Specific Gravity (Gmb) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens*** with the following modifications:

AASHTO T166-21 Section	**WisDOT Modification:**
1.2	*Replace Section 1.2 with the following:* This method should not be used with SMA specimens. If the specimen is SMA, then use WTM T331.
2.1	*Remove the following reference:* AASHTO T275 - Bulk Specific Gravity (Gmb) - Paraffin-Coated *Replace the AASHTO R79 and T331 references with the following WisDOT Modified versions:* WTM R79 – Vacuum Drying Compacted Asphalt Specimens WTM T331 – Bulk Specific Gravity (Gmb) Using Vacuum Sealing
3.1.2	*Remove Section 3.1.2 – Constant Mass*
6.1	*Replace Section 6.1 with the following:* Recently compacted laboratory specimens, which have not been exposed to moisture, do not require drying. **Note 1**: If either the Gmm (WTM T209) or Gmb (WTM T166) samples are conditioned, then both the Gmm and Gmb must be conditioned for the same amount of time, not to exceed 1 hour. Samples exposed to moisture or cored samples require drying according to WTM R79.
6.2	*Replace Section 6.2 with the following:* 1. Weigh each SGC specimen (cooled according to Note 6 in WTM T312) in air and record the dry mass as *A (to 0.1g)*. 2. Water bath temperature is to be maintained at 25 ± 1 °C (77 ± 2°F). 3. Submerge the specimens in 25 ± 1 °C (77 ± 2°F) water bath for 4 ± 1 min. Weigh under water, and record (to 0.1g). Designate this weight as C (for formula). For SMA follow WTM T331. 4. Surface dry the specimen by blotting quickly (5 sec) with a damp towel, (the entire operation is not to exceed 15 seconds) then weigh in air, and record (to 0.1 g). Designate this weight as B (for formula). **Note 2**: When testing HMA or SMA cores collected from pavement, the sequence of testing cannot be changed. Always measure the dry mass first, followed by the submerged mass and finally the saturated surface-dry mass.

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	Note 3: Damp is considered to be when no water can be wrung from the towel.
7.2	*Remove Section 7.2*
7.3	*Remove Section 7.3*
8 – 10	*Remove Method B – the entirety of Sections 8 through 10*
11 – 12	*Remove Method C – the entirety of Sections 11 through 12*
13.1.1	*Replace Section 13.1.1 with the following:* Use Method A.
13.13	*Remove Section 13.1.3*
13.1.4	*Add Section 13.1.4 with the following:* Report the average Gmb of 2 specimens. If one of the individual samples deviates by more than 0.015 from the other, results are considered suspect and a new set of specimens is compacted. For QMP, the new set of specimens shall be taken from the contractor retained sample (following the rule-of-retained). For PWL, the new set of specimens shall be taken from the "Extra" split sample. For SMA, report the average Gmb of 4 lab compacted specimens. If one of the individual specimens deviates by more than +/- 0.015 from the average, results are considered suspect and the result furthest from the average should be removed from the calculation. Calculate the average using the remaining 3 specimens.

WTM T209

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T209 ***Standard Method of Test for Theoretical Maximum Specific Gravity (Gmm) and Density of Hot Mix Asphalt (HMA)*** with the following modifications:

<table>
<tr><th>AASHTO T209-20 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO R30, R47 and R97 references with the following WisDOT Modified versions:</i>
WTM R30 – Mixture Conditioning of HMA
WTM R47 – Reducing Samples of HMA to Testing Size
WTM R97 – Sampling HMA Mixtures</td></tr>
<tr><td>5.11</td><td><i>Add Section 5.11: Apparatus</i>
<i>Automatic Digital Manometer/Controller System</i> – an automatic timer system combines the vacuum pressure, time, and vibration of the mechanical agitator into one device. This system allows precise control of vacuum pressure and time and can be equipped to monitor the vibration energy of the rice shaker. The use of automatic timer systems (ex: AutoRice) are acceptable as approved by the agency.</td></tr>
<tr><td>6.3</td><td><i>Replace Section 6.3 with the following:</i>
The size of the sample shall conform to the following requirements. Samples larger than the capacity of the container shall be tested a portion at a time.
When performing this test on a No. 3 (19.0mm) sample or finer, a pycnometer bowl (2000 g capacity/6 in. depth) is required. When performing this test on a No. 2 (25.0mm) sample or coarser, a larger pycnometer bowl (4000 g capacity/10 in. depth) can be used, or the sample can be split into two separate samples tested using the 2000 g capacity pycnometer and following the calculations to combine the sample in Section 12.2.1.</td></tr>
<tr><td>Table 1</td><td><i>Replace Table 1 with the following: Minimum sample sizes</i>
<table>
<tr><th colspan="2">Gmm (RICE) Sample Size</th></tr>
<tr><td>37.5mm (No. 1)</td><td>4000 Grams</td></tr>
<tr><td>25.0mm (No.2)</td><td>3000 Grams</td></tr>
<tr><td>19.0mm (No. 3)</td><td>2000 Grams</td></tr>
<tr><td>12.5mm (No. 4)</td><td>1500 Grams</td></tr>
<tr><td>9.5mm (No. 5)</td><td>1000 Grams</td></tr>
<tr><td>4.75mm (No. 6)</td><td>1000 Grams</td></tr>
</table></td></tr>
<tr><td>7.2.1</td><td><i>Replace Section 7.2.1 with the following: Sample Preparation</i></td></tr>
</table>

	If the either the Gmm (WTM T209) or Gmb (WTM T166) samples require reheating, then both the Gmm and Gmb must be reheated for the same amount of time, not to exceed 1 hour.
7.4	*Replace Sections 7.4 with the following:* Tare the balance with the pycnometer/bowl.
7.5	*Replace Section 7.5 with the following:* Cool the sample to room temperature, and place the sample into the tared pycnometer/bowl. A container within a container is not to be used. Determine and record the mass of the sample. Record the mass of the sample as *A, to the nearest 0.1g*.
7.6.1	*Add Section 7.6.1:* Stir the material to allow for trapped air bubbles to be released and add the lid and vacuum apparatus.
12.3.1	*Replace Section 12.3.1 with the following:* Calculate the corresponding theoretical maximum density at 25°C (77°F) as follows: Theoretical maximum density at 25°C (77°F) = theoretical specific gravity x 997.1 kg/m^3 in SI units. Or Theoretical maximum density at 25°C (77°F) = theoretical specific gravity x 62.24 lb./ft^3 in inch-pound units. Where: The density of water at 25°C (77°F) = 997.1 kg/m^3 in SI units or 62.24 lb./ft^3 in inch-pound units.
Note 8	*Replace Note 8 with the following:* The dry back procedure is required for aggregate JMF blends with moisture absorption greater than or equal to 2.0%.
14.1.1	*Add the following to Section 14.1.1:* For HMA, report the Gmm of 1 sample with respect to section 6.3 if samples are split for testing. For SMA, report the average Gmm of 2 samples. For SMA, if one of the individual samples deviates by more than 0.015 from the other, results are considered suspect, and an additional set of samples is measured. For QMP, the new set of specimens shall be taken from the contractor retained sample (following the rule-

	of-retained). For PWL, the new set of specimens shall be taken from the "Extra" split sample.

WTM T269

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T269 ***Standard Method of Test for Air Voids in Compacted Dense and Open Asphalt Mixtures*** with the following modifications:

AASHTO T269-14 (2018) Section	**WisDOT Modification:**
2.1	*Replace the AASHTO T166, T209, T312 and T331 references with the following WisDOT Modified versions:* WTM T166 – Bulk Mix Gravity (Gmb) WTM T209 – Theoretical Maximum Specific Gravity (Gmm) WTM T312 – Superpave Gyratory Compactor WTM T331 - Automatic Vacuum Sealing Method
6.2	*Replace Section 6.2 with the following:* For SMA mixtures, use the WTM T331 - Automatic Vacuum Sealing Method:
6.2.2	*Remove Section 6.2.2 – Volume Method*

WTM T283

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T283 ***Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage*** with the following modifications:

AASHTO T283-21 Section	WisDOT Modification:
2.1	*Replace the AASHTO R30, R47, R97, T166, T209, and T312 references with the following WisDOT Modified versions:* WTM R30 – Mixture Conditioning of HMA WTM R47 – Reducing Samples of HMA to Testing Size WTM R97 – Sampling HMA Mixtures WTM T166 – Bulk Mix Gravity (Gmb) WTM T209 – Theoretical Maximum Specific Gravity (Gmm) WTM T312 – Superpave Gyratory Compactor *Add the following reference:* WTM T269 – Percent Air Voids.
3.1	*Replace Section 3.1 with the following:* As noted in the scope, this method is intended to evaluate the effects of saturation and accelerated water conditioning of compacted asphalt mixtures. This method can be used to test: (a) asphalt mixtures in conjunction with mixture design testing (lab-mixed, lab-compacted); (b) asphalt mixtures produced at mixing plants (field-mixed, lab-compacted); and (c) asphalt mixture cores obtained from completed pavements of any age (field-mixed, field-compacted).
3.2	*Replace Section 3.2 with the following:* Numerical indices of retained indirect-tensile properties are obtained by comparing the properties of laboratory specimens subjected to moisture conditioning with the similar properties of dry specimens.
4.1	*Replace Section 4.1 with the following:* Test specimens for each set of mix conditions, such as those prepared with untreated asphalt binder, asphalt binder treated with antistripping agent, or aggregate treated with lime, are prepared. Each set of specimens is divided into subsets. One subset is tested in dry condition for indirect-tensile strength. The other subset is subjected to vacuum saturation, followed by a warm-water soaking cycle, before being tested for indirect-tensile strength. Numerical indices of retained indirect-tensile strength properties are calculated from the test data obtained by the two subsets: dry and conditioned.
5.5	*Remove Section 5.5*

6.1	*Replace Section 6.1 with the following:* Preparation of Laboratory-Mixed, Laboratory Compacted Samples Prepare mixture for at least six specimens for each test, half to be tested dry and the other half to be tested after partial saturation and moisture conditioning. Note 1 – It is recommended that mixture for at least two additional specimens for each set be prepared. These specimens can then be used to establish compaction procedures for specimen void content as given in Section 6.2 and the vacuum saturation technique as given in Section 10.4.
6.2	*Replace Section 6.2 with the following:* The voids target can be obtained by adjusting the mass of the mixture; or adjusting the number of gyrations or specimen height in WTM T312. The effective adjustment must be determined experimentally for each mixture before compacting the specimens for each set.
6.3	*Replace Section 6.3 with the following:* Specimens 6 in. (150mm) in diameter by 95 ± 5 mm thick are used.
6.6	*Replace Section 6.6 with the following:* Place the mixture in an oven for 2 h ± 10 min at the compaction temperature ±3°C (5°F). Determine the compaction temperature according to WTM T312.
6.7	*Replace Section 6.7 with the following:* For HMA samples, compact the specimens according to WTM T312 to 7.0 ± 0.5 percent air voids according to WTM T269. For SMA samples, compact the specimens according to WTM T312 to 7.0 ± 1.0 percent air voids according to WTM T269.
7.3	*Replace Section 7.3 with the following:* Preparation of Field-Mixed Make at least six specimens for each test, half to be tested dry and the other half to be tested after partial saturation and moisture conditioning.
7.3.1	*Replace Section 7.3.1 with the following:* Prepared compacted specimens shall be 7.0 ± 0.5 percent air voids according to WTM T269. This level of voids can be obtained by adjusting the mass of the mixture; or adjusting the number of gyrations or specimen height in WTM T312. The effective adjustment must be determined experimentally for each mixture before compacting the specimens for each set.
7.4	*Replace Section 7.4 with the following:* Specimens 6 in. (150mm) in diameter by 95 ± 5 mm thick are used.
9.6	*Replace the first sentence of Section 9.6 with the following:*

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	For those specimens to be subjected to vacuum saturation and a warm-water soaking cycle, calculate the volume of air voids (Va) in cubic centimeters using the following equation:
10.1	*Replace Section 10.1 with the following:* Preconditioning of Test Specimens One subset will be tested dry, and the other will be partially vacuum saturated, and soaked in warm water before testing.
10.4.1	*Replace Section 10.4.1 with the following:* Preconditioning of Test Specimens Place the specimen in the vacuum container supported a minimum of 1 in. (25mm) above the container bottom by a perforated spacer. Fill the container with water at room temperature so that the specimens have at least 1 in. (25mm) of water above the surface.
10.4.9	*Remove section 10.4.9*
10.4.10	*Replace Section 10.3.8 with the following:* Preconditioning of Test Specimens Place the specimens in a bath containing water at 60 ± 1°C (140 ± 2°F) for 24 ± 1 hour. the specimens should have a minimum of 1 in. (25mm) of water above their surface.
12.2	*Remove any reference to "freeze-thaw" in this section.*

WTM T308

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T308 ***Standard Method of Test for Determining the Asphalt Binder Content of Asphalt Mixtures by the Ignition Method*** with the following modifications:

AASHTO T308-21 Section	**WisDOT Modification:**
1.1	*Replace with the following:* Scope This test method covers the determination of asphalt binder content of hot mix asphalt (HMA) by ignition oven at temperatures that reach the flashpoint of the binder in a furnace. The means of specimen heating must be the convection method. The aggregate remaining after burning can be used for sieve analysis using AASHTO T30.
2.1	*Replace the AASHTO R47, R76, R90, T97, and T329 references with the following WisDOT Modified versions:* WTM R47 – Reducing Samples of HMA to Testing Size WTM R76 – Reducing Samples of Aggregate WTM R90 – Sampling of Aggregate WTM R97 – Sampling HMA Mixtures WTM T329 – Moisture Content by Oven Method
3.1	*Replace Section 3.1 with the following:* Summary of Test Method The asphalt binder in the HMA is ignited using the furnace equipment applicable to the particular method. Method A requires an ignition furnace with an internal balance and is the method required for WisDOT testing.
5.1	*Replace Section 5.1 with the following: Ignition Furnace* Ignition Furnace - A forced-air ignition furnace that heats the specimens by convection method. The convection-type furnace must be capable of maintaining a temperature of 538 ± 5°C (1000 ± 9°F). The furnace chamber dimensions shall be adequate to accommodate a specimen size of 3500 g. The furnace door shall be equipped so that the door cannot be opened during the ignition test. A method for reducing furnace emissions shall be provided. The furnace shall be vented into a hood or to the outside and, when set up properly, shall have no noticeable odors escaping into the laboratory. The furnace shall have a fan capable of pulling air through the furnace to expedite the test and reduce the escape of smoke into the laboratory.
Table 1	*Replace Table 1 with the following:* Refer to WTM R47 – Reducing samples of HMA to testing size, for sample sizes.

7.1.1	*Replace Section 7.1.1 with the following: Test Initiation* For the convection-type furnace, preheat the ignition furnace to 482 ± 5°C (900 ± 9°F) or to the temperature determined by the correction factor process in the Annex. Manually record the furnace temperature (set point) before beginning the test if the furnace does not record automatically.
7.1.2	*Remove Section 7.1.2*
Note 6	*Delete Note 6.*
8	*Remove the entire Section 8:* Test Procedures – Method B
10.1.1	*Replace with the following:* Report Test Method A
10.1.8.	*Add Section 10.1.8. – Sample Label:* Include the following information on each individually packaged IOCF sample: 1. Contractor testing lab and certified technician name. 2. Date. 3. Type of asphaltic mixture. 4. Lab-batched or field produced material. 5. Contractor's mix ID for lab batched or WisDOT ID (250-XXXX-YR) for plant-produced. 6. Percent binder, virgin aggregate, and RAM. 7. Reason for Submittal
11.1	*Replace Section 11.1 with the following:* Precision and Bias *Precision* - Criteria for judging the acceptability of ignition burn results for asphalt content obtained by Method A is given in Table 2.
A2.4	*Replace Section A2.4 with the following:* Correction Factor Procedure Prepare two correction specimens at the regressed asphalt binder content corresponding to 3.0% air void regressed design, or 4.5% air void design for SMA. Aggregate used for correction specimens shall be sampled from material designated for use in production.
A2.6	*Replace Section A2.6 with the following:* Correction Factor Procedure Test Specimens according to Method A.
A2.8.1	*Replace Section A2.8.1 with the following:* Correction Factor Procedure If the asphalt binder correction factor exceeds 1.0%, the test temperature must be lowered to 427 ± 5°C (800 ± 8°F) for a convection-type furnace, and new samples must be burned. (Repeat step A2.5 – A2.8 using the lower temperature).

	If there is no improvement in the correction factor, it is permissible to use the higher temperature. Note A2 – The temperature for determining the asphalt binder content of the asphalt mixture specimens by this procedure shall be the same temperature determined in the correction specimens.
A2.8.2	*Remove Section A2.8.2*
A2.9	*Add the following to Section A2.9:* Section A2.9 is only required for QC laboratories.

WTM T312

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Follow AASHTO T312 ***Standard Method of Test for Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor*** with the following modifications:

AASHTO T312-19 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R30, R47, R97, T166, T209 and T275 references with the following WisDOT Modified versions:* WTM R30 – Mixture Conditioning of HMA WTM R47 – Reducing Samples of HMA to Testing Size WTM R97 – Sampling HMA Mixtures WTM T166 – Bulk Mix Gravity (Gmb) WTM T209 – Theoretical Maximum Specific Gravity (Gmm) WTM T331 – Bulk Specific Gravity (Gmb) Using Vacuum Sealing
Note 3	*Replace Note 3 with the following: Laboratory Prepared* For Wisconsin aggregates and designs a range of 4700 - 4900g is generally appropriate to achieve this height for aggregates with combined bulk specific gravities (Gsb) of 2.550 to 2.700, respectively.
8.1.7.1	*Remove Section 8.1.7.1 – Refer to section 9.2 for compaction temperatures.*
8.2.5	*Replace Section 8.2.5 with the following: HMA Mixture Preparation* Bring the HMA to the compaction temperature range by careful, uniform heating in an oven immediately before molding. Heat sample for no more than one hour, in an open container in an oven set at a temperature not to exceed +25°C (+45°F) above the compaction temperature listed on the mix design. If binder modifiers or additives are used, compact to the supplier's temperature recommendations. Note, for such mixes, e.g., WMA, this compaction temperature should match that specified on the mix design submittal. After quartering to test size, if the mix sample is within the proper compaction temperature range, then the specimen can be compacted without further heating.
9.1	*Replace Section 9.1 with the following:* Preheat specimen molds and base plate(s). It is recommended to use a heat lamp to preheat any utensils used. When the mix is at compaction temperature, remove the heated mold, base plate, and upper plate (if required) from the oven. Place the base plate and a paper disk in the bottom of the mold.
9.2	*Replace Section 9.2 with the following: Compaction Procedure*

	Charge the mold, in one lift rotating the scoop/pan/bowl to avoid segregation of material within the mold. With a spatula, lightly level the mix on the top. Re-ensure the mix is at the proper compaction temperature as follows. Compaction temperature is 132 – 137°C (275 ± 5°F) for all mixes, except when: • Using a warm mix additive with a lower compaction temperature listed on the approved mix design (± 5°F). Place another specimen protection disc on top of the mix and, if your gyratory requires it, place the mold top-plate on the paper disc. Load the mold into the SGC (according to manufacture instructions).
9.5	*Replace Section 9.5 with the following:* Allow compaction to proceed until the desired number of gyrations on each SGC specimen is reached.
Note 6	*Replace Note 6 with the following:* After compaction is completed, the specimen is extruded, protection papers are removed, the briquette is labeled, and cooling by fan is required for a period of at least 1 hour. The specimens can be extruded from the mold immediately after compaction for most asphalt mixtures. If the mixture is extremely fine or tender, then the initial 5 - 10 minutes of cooling should take place while the specimen is only partially extruded to aid in handling.
10	*Remove Section 10.*
11	*Remove Section 11.*
12.1.11	*Remove Section 12.1.11.*
12.1.12	*Remove Section 12.1.12.*
A1.1	*Replace paragraph 2 with the following:* *Minimum frequency of this evaluation is 12 months.*

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WTM T321

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Follow AASHTO T321 ***Standard Method of Test for Determining the Fatigue Life of Compacted Asphalt Mixtures Subjected to Repeated Flexural Bending*** with the following modifications:

AASHTO T321-22 Section	WisDOT Modification:
2.1	*Replace the AASHTO R66, R90, R97 and T269 references with the following WisDOT Modified versions:* WTM R66 – Sampling Asphalt Materials WTM R90 – Sampling Aggregate Products WTM R97 – Sampling Asphalt Mixtures WTM T269 – Percent Air Voids in Compacted Dense and Open Asphalt Mixtures *Add the following WisDOT Modified version:* WTM R30 – Mixture Conditioning of HMA
3.1.1	*Replace Section 3.1.1 with the following:* *Failure point* – the failure criterion in 50% of the initial flexural stiffness measured at the 200th load cycle at 2,000 microstrain.
7.1	*Replace Section 7.1 with the following:* *Laboratory-Mixed and Compacted Specimens* – Sample asphalt binder in accordance with WTM R66 and sample aggregate in accordance with WTM R90. Prepare two replicate asphalt mixture beam specimens, from slabs(s) or beams(s) compacted in accordance with PP 3 or T 247. Age laboratory prepared mixtures in accordance with WTM R30.
7.2	*Replace Section 7.2 with the following:* *Plant-Mixed and Compacted Specimens* – Obtain asphalt mixture samples in accordance with WTM R97. Prepare two replicate asphalt mixture beam specimens, from slabs(s) or beams(s) compacted in accordance with PP 3 or T 247. Age laboratory prepared mixtures in accordance with WTM R30.

WTM T324

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Follow AASHTO T324 ***Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures*** with the following modifications:

AASHTO T324-19 Section	**WisDOT Modification:**
1.2	*Replace Section 1.2 with the following:* This method describes the testing of a submerged, compacted asphalt mixture in a reciprocating rolling-wheel device. This test provides information about the rate of permanent deformation from a moving, concentrated load. WisDOT requires the use of the Superpave Gyratory Compactor (SCG) designed to compact specimens in the laboratory. When cores are tested, WisDOT requires field cores having a diameter of 150mm (6 in.).
2.1	*Replace the AASHTO R30, R97, T166, T209, T269 and T312 references with the following WisDOT Modified versions:* WTM R30 – Mixture Conditioning of HMA WTM R97 – Sampling HMA Mixtures WTM T166 – Bulk Mix Gravity (Gmb) WTM T209 – Theoretical Maximum Specific Gravity (Gmm) WTM T269 – Percent Air Voids WTM T312 – Superpave Gyratory Compactor
5.1	*Replace Section 5.1 with the following:* Hamburg Wheel-Tracking Device: An electrically powered machine capable of moving a 8 ± 0.08 in. (203.2 ± 2.0mm) diameter, 1.85 ± 0.02 in. (47 ± 0.5mm) wide steel wheel over the center (x and y axes) of the test specimen. The load on the wheel is 703 ± 4.5 N (158.0 ± 1.0 lb.). The wheel reciprocates over the specimen, with the position varying sinusoidally over time. The wheel makes 52 ± 2 passes across the specimen per minute. The maximum speed of the wheel, reached at the midpoint of the specimen, is 1 ± 0.066 ft/s (0.305 ± 0.02 m/s). Delete note 1
6.2.4	*Replace Section 6.2.4 with the following:* Condition test samples at the appropriate temperature in accordance with the short-term conditioning procedure for mechanical properties in WTM R30.
6.2.5	*Replace Section 6.2.5 with the following:* Use the compaction temperature listed on the mix design.
6.2.6	*Replace Section 6.2.6 with the following:* Compact SGC cylindrical specimens.

6.2.6.1	*Remove Section 6.2.6.1 – Compacting Slab Specimens*
6.2.6.2	*Replace Section 6.2.6.2 – Compacting SGC Cylindrical Specimens with the following:* Compact two 6 in. (150mm) diameter specimens in accordance with WTM T312. Specimen thickness must be 60 ± 1mm thick. Allow compacted specimen to cool at normal room temperature on a clean, flat surface until cool to the touch.
7.3	*Replace Section 7.3 with the following:* Determine the air void content of the specimens in accordance with WTM T269. The required target air void content is 7.0 +/- 0.5% for laboratory-compacted SGC cylindrical specimens. Field specimens may be tested at the air void content at which they are obtained.
8.6.1	*Replace Section 8.6.1 with the following:* Select the test temperature of 46° C.
8.6.3	*Replace Section 8.6.3 with the following:* Select 20,000 as the maximum number of passes.
9.1	*Replace Section 9.1 with the following:* For the purposes of this method, a “test” is defined as: Four 6 in. (150mm) diameter specimens grouped in pairs (1 and 1b) representing similar material run in the Hamburg Wheel-Tracking Device simultaneously. Test results will be reported as the average value both pairs of specimens.
9.2	*Replace 9.2 with the following:* The maximum rut depth shall be calculated based on the average rut depth for the seven middle deformation locations. The corrected rut depth shall be calculated using the worksheet provided by the department.
9.3	*Replace 9.3 with the following:* The stripping number shall be calculated using the worksheet provided by the department.

WTM T329

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Follow AASHTO T329 ***Standard Method of Test for Moisture Content of Asphalt Mixtures by Oven Method*** with the following modifications:

AASHTO T329-15 Section	**WisDOT Modification:**
2.1	*Throughout the AASHTO T359 and this modification, replace any reference to the AASHTO Standards R47 and T168 with the following WisDOT Modified versions:* WTM R47 – Reducing Samples of HMA to Testing Size WTM R97 – Sampling HMA Mixtures
6.6	*Replace Section 6.6 with the following:* Dry the sample initially for 90 ± 5 min, using an oven at 163 ± 14°C (325 ± 25°F), and determine its mass. Then continue to dry the sample to constant mass, checking at 15 ± 5-min intervals until further drying does not alter the mass by more than 0.05%.

WTM T331

Effective with January 2025 Letting
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Follow AASHTO T331 ***Standard Method of Test for Bulk Specific Gravity (Gmb) and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method*** with the following modifications:

AASHTO T331-21 Section	**WisDOT Modification:**
1.2	*Replace Section 1.2 with the following:* This method should be used with samples that contain open or interconnecting voids. Due to the open nature and surface texture of SMA mixtures, and the associated variability using AASHTO T166 in determining the bulk specific gravity (Gmb) of compacted SMA specimens, AASHTO T331 (Density by Automatic Vacuum Sealing) is the required procedure to measure that property.
2.1	*Remove the following reference:* AASHTO T275 *Replace the AASHTO R79, T166 and T312 references with the following WisDOT Modified versions:* WTM R79 – Vacuum Drying Compacted Asphalt Specimens WTM T166 – Bulk Mix Gravity (Gmb) WTM T312 – Superpave Gyratory Compactor *Add the following references:* WTM R97 – Sampling HMA Mixtures WTM R47 – Reducing Samples of HMA to Testing Size
3.1.2	*Replace Section 3.1.2 with the following:* Constant mass – specimens are considered constant mass when the specimen achieves the *dry specimen condition* as defined in WTM R79.
4.3	*Replace Section 4.3 with the following:* Specimens shall be taken from pavements according to WTM R67.
6.1	*Replace Section 6.1 with the following:* *Initial Mass of Specimen in Air* –Vacuum-dry the specimens according to WTM R79. Recently compacted laboratory samples that have not been exposed to moisture do not require drying. Allow newly compacted SGC specimens to cool for by fan, lying upright on the flat face, for a minimum of one hour, after compaction time. Record the initial dry mass as A.
7.3	*Add Section 7.3 with the following:* Refer to WTM T166 for additional reporting requirements.

8.1.1	*Revise Section 8.1.1 with the following:* The vacuum settings of the device shall be verified once every six months, after repairs, and after shipment or relocation, as a minimum.
8.2	*Remove the entirety of Section 8.2 – Plastic Bag Verification*

WTM T355

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T355 ***In-Place Density of Asphalt Mixtures by Nuclear Methods*** with the following modifications:

AASHTO T355-18 Section	WisDOT Modification:
2.1	*Replace the AASHTO T166, T209, and T331 references with the following WisDOT Modified versions:* WTM T166 – Bulk Mix Gravity (Gmb) WTM T209 – Theoretical Maximum Specific Gravity (Gmm) WTM T331 – Automatic Vacuum Sealing Method
4.1.3	*Replace Section 4.1.3 with the following:* Other radioactive sources must not be within 10 m (30 ft) of the gauge in operation. The operator must not be within 1 m (3 ft), and any bystanders must not be within 5 m (15 ft). Additionally, the gauge must be kept the following minimum distances from: • Pavement transverse construction joints: 20 feet • Bridge deck expansion joints: 20 feet • Equipment, manholes, etc.: 15 feet • Unrestricted edge of pavement: 1.5 feet* • Restricted edge of pavement: 1 foot* • Walls or vertical mass: 5 feet *does not apply for longitudinal joint density tests
4.1.4	*Remove Section 4.1.4*
4.1.5	*Remove Section 4.1.5*
5.7	*Add Section 5.7 with the following:* In addition to certification of the operator, the department requires that all individual nuclear moisture / density gauges used on WisDOT projects be on the approved list. This policy applies to all WisDOT, consultant, and contractor gauges used for acceptance or QMP density testing. Each gauge must be within 30 years of the Cesium-137 manufacture date as identified on the gauge's source plate or handle.
6	*Replace Section 6 –* ***Hazards****, with the following:* The State of Wisconsin Department of Health Services (DHS), Radiation Protection Section issues a license to WisDOT specifying that use of radioactive gauges by the department be supervised by the WisDOT Radiation Safety Officer (RSO). The RSO must be kept informed of the location and usage activities of WisDOT nuclear gauges

	at all times. The WisDOT RSO contact information will be supplied to each user of a WisDOT nuclear density gauge. The WisDOT RSO may be contacted at the following telephone numbers: (608) 516-6359, Primary (920) 492-5626, Green Bay Office Nuclear gauge owners are responsible for compliance with State of Wisconsin DHS Radioactive Materials license or NRC license requirements. In addition, they must comply with WisDOT requirements when engaged in work on WisDOT projects. Personnel who either use nuclear gauges or directly supervise the use of gauges must be trained in radiation safety and transportation of radioactive materials and must maintain the appropriate Highway Technician Certification Program (HTCP) certifications.
6.1	*Replace Section 6.1 with the following:* **Lost or Stolen Gauges:** If a gauge is lost or stolen, notify the Radiation Safety Officer (RSO) as soon as possible. The RSO will notify the appropriate regulatory agency per DHS 157.
6.2	*Replace Section 6.2 with the following:* **Damaged Gauges:** The operator will follow these procedures in the event of gauge damage (per DHS 157 Appendix H). All companies must have available an appropriate radiation survey meter in accordance with http://docs.legis.wisconsin.gov/code/admin_code/dhs/110/157.pdf • Seal off the area for a distance of 15 feet around the gauge in question to prevent exposure to themselves and others. Protect the gauge from further damage. • Stop the vehicle or heavy piece of equipment that is involved, it must be detained in order to verify that it is not contaminated. • Never let the gauge in question be left unattended. • Visually inspect the gauge to determine the extent of the damage to the source(s), source housing(s), and shielding. Check the base of the gauge for any splits or punctures. Take Pictures, take notes and statements to document incident. • Do not handle the gauge if it has been damaged severely enough that source rod or internal shielding is cracked or broken open. • Notify the Radiation Safety Officer (or notify supervisor who will contact the RSO) as soon as possible. The RSO will notify the appropriate regulatory agency. • Follow the instructions of the RSO.
7.1	*Replace Section 7.1 – **Calibration**, with the following:* Each gauge must be calibrated and verified annually and before each construction season as follows: 1. Calibrate the gauge by a manufacturer approved calibration service provider.

	2. Then additionally verify calibration of the gauge using BTS gauge blocks Contact the WisDOT RSO for appointment scheduling and for current year procedures. This procedure must be repeated if the gauge is sent in for any manufacturer calibration or service during the construction season. WisDOT maintains an annual list of consultants and contractors certified gauges approved to perform nuclear testing on WisDOT administered projects. Consultants and contractors must be on this list to perform acceptance and nuclear gauge testing on WisDOT projects. This list is established and maintained by the Quality Assurance Unit in central office and is on the APL. To verify that the department has the correct information for your company, you must submit the following information yearly: 1. Current copy of your Wisconsin Agreement State License or your Federal Nuclear Regulatory Commission (NRC) license. 2. Copies of current nuclear moisture and density gauge 3 block calibration certificates (5 blocks for other states) conducted by the manufacturer or an approved calibration service. 3. Company contact person, RSO, or safety officer (please update as changes occur). 4. The WisDOT Block Calibration form (including new constants). Please send this information to: Wisconsin Department of Transportation Bureau of Technical Services, Truax Center ATTN: WisDOT RSO 3502 Kinsman Blvd Madison WI 53704-2507 (Note: email is the primary means of sending this information)
8.2	*Add the following to Section 8.2:* **Standardization:** The operator will take new standard counts for density and moisture at the project. This check must be done daily on all manufacturers' gauges. A new standard is required if testing different materials on the same day (e.g., testing aggregate base and then switching to HMA testing).
8.2.1	*Add the following to Section 8.2.1:* Gauges must be warmed up and checked following the manufacturer's guidelines.
8.2.2	*Remove Section 8.2.2*
8.2.3	*Remove Section 8.2.3*
8.3	*Add Section 8.3 – **QMP QC and QV Nuclear Density Gauge Comparison**:* ***For HMA Projects (Optional for QMP PWL and QMP SMA Projects):***

	Select a representative section of the compacted HMA pavement on or before the first day of paving for the comparison process. The section does not have to be the same mix design. Compare the 2 or more gauges used for density measurements (QC, QV). The QC and QV gauge operators will perform 5 four-minute density tests at jointly determined sites. Record the density measurement of each test site for the QC, QV and other acceptance gauges. Calculate the average of the difference in density between the QC and QV gauges of the 5 test sites. If the average difference exceeds 1.0 pcf investigate the cause, perform a new reference standard count, and conduct a second gauge comparison procedure. The 5 jointly-determined sites in the second gauge comparison do not need to be the same as those used in the first comparison. If the second gauge comparison procedure also results in an average difference exceeding 1.0 pcf, the regional HMA Coordinator, with the consultation of the RSO, will use their gauge to investigate the situation with the QC and QV personnel to determine necessary actions.
8.4	*Add Section 8.4 with the following:* ***Reference Site Monitoring Required for all Paving Projects:*** After performing the gauge comparison, establish a project reference site approved by the department. Clearly mark a flat surface of concrete or asphalt or other material that will not be disturbed for the duration of the project. Perform reference site monitoring of the QC, QV, and any additional gauges at the project reference site. Conduct an initial 5 four-minute density tests with each gauge on the project reference site and calculate the average value for each gauge to establish the gauge's reference value. Use the gauge's reference value as a control to monitor the calibration of the gauge for the duration of the project. Check each gauge on the project reference site at least once a day before performing any density testing. Calculate the difference between the gauge's test result and its reference value. Investigate if a daily test result is not within 1.5 pcf of its reference value. Conduct 3 additional four-minute tests at the reference site once the cause of the deviation is corrected. Calculate and record the average of the 3 additional tests. Remove the gauge from the project if the 3 test average is not within 1.5 pcf of its reference value. The regional HMA coordinator will use their gauge to investigate these situations with the QC and QV personnel to determine necessary actions. For non QMP HMA Nuclear Density projects, the regional block can be used as the project reference site. If this option is used, each gauge needs to be within 1.0 pcf of the block's reference value.
9.1	*Replace Section 9.1 with the following:* Select a relatively smooth and flat test location. The operator must check the test location for being level below the gauge. To ensure that the surface is flat, check opposite corners of the gauge for rocking. When the test site does not meet the above conditions, the site may be moved within 5 feet ahead or back and 2 feet right or left of the selected site. If this adjustment in the site location will still not meet the above criteria for finding a level test location, randomly select a new test site. Record your reason in the remarks area on the work form and notify the project engineer.

	Once the test location has been set the gauge reading at that location must be counted as a legitimate test.
9.2.1	*Replace Section 9.2.1 with the following:* Maintain maximum contact between the base of the gauge and the surface of the material under the test.
9.3.1	*Remove all Sections of 9.3.1 – Alternate 1 – 90 degree Rotation*
9.3.2.1	*Replace Section 9.3.2.1 with the following:* The density gauge shall be placed with the longest dimension of the gauge positioned parallel to the edge of the pavement and with the source rod oriented towards the direction of paving for the first test. Outline the gauge with a lumber crayon or paint stick and show the direction of the source. Then place the probe in the backscatter position.
9.3.2.2	*Replace Section 9.3.2.2 with the following:* Take a one minute test when using CPN, Troxler, Humboldt and InstroTek gauges. Tests with Seaman gauges require thirty seconds in both contact mode and in air gap mode.
9.3.2.4	*Replace Section 9.3.2.4 with the following:* Take another one minute test when using CPN, Troxler, Humboldt and InstroTek gauges. Tests with Seaman gauges require thirty seconds in both contact mode and in air gap mode.
9.3.2.5	*Replace Section 9.3.2.5 with the following:* If the difference between the two tests is more than 1.0 pcf, a third test is conducted in the same orientation as the first test (parallel to the edge of the pavement with the source rod oriented towards the direction of paving).
9.3.2.6	*Replace Section 9.3.2.6 with the following:* Record the sublot number, percent compaction and density in lbs/ft^3 on the pavement for all tests with a lumber crayon or paint stick. When calculating test location results, if two readings were taken average the two readings and report average to the nearest 0.1pcf. Average the two readings to nearest 0.1 pcf is used to represent the location for the gauge. In the event a third reading is taken, all three readings are averaged to the nearest 0.1 pcf, the individual test reading of the three which falls farthest from the average value is discarded, and the average of the remaining two values to the nearest 0.1 pcf is used to represent the location for the gauge. If one of the three tests is exactly equal to the average of all three, or two tests are equidistant and the third test is 0.1 pcf away from the average of all three, use the average of all three tests to the nearest 0.1 pcf to represent the location. The HMA Density Field Worksheet can be used to calculate the average density at each test

site. This worksheet can be found at the WisDOT AASHTOWare Project Knowledge Base (AWKB) website:

https://awpkb.dot.wi.gov/Content/constr/Pantry/StatewideXLS.htm

When calculating the pcf value and percent of maximum density (Gmm), round to the nearest tenth place (0.1) for all individual test results and the overall average (according to Section 10.1.1). When calculating the distance from the average for individual one-minute readings, each distance from the average value must be rounded to the nearest 0.1 pcf.

Example 1
Target Gmm= 2.440
Target Max Density (pcf) = 151.9

Lot-Sublot	Readings (pcf)			Intermediate Average (pcf)	Test Distance from Average (pcf)			Final Average (pcf)	%Max Density
	1	2	3		1	2	3		
1-1A	140.0	142.0	141.0	141.0	1.0	1.0	0.0	141.0	92.8%
1-1B	140.0	142.3	141.0	141.1	1.1	1.2	0.1	140.5	92.5%
1-1C	140.0	141.0	-	140.5	0.5	0.5	-	140.5	92.5%
1-1D	140.0	143.0	141.6	141.5	1.5	1.5	0.1	141.5	93.2%

1-1A: One of the readings is exactly equal to the intermediate average (reading 3) so the average of all three readings to the 0.1 pcf is used.

1-1B: None of the readings are exactly equal to the intermediate average so the one furthest from the intermediate average is discarded (reading 2). The remaining two readings are averaged to the nearest 0.1 pcf.

1-1C: The difference between the first two readings is not more than 1.0 pcf so a third reading is not needed. The two readings are averaged to the nearest 0.1 pcf.

1-1D: The difference between two readings (reading 1 and 2) are equidistant from the intermediate average and one reading (reading 3) is 0.1 pcf away from the intermediate average. All three readings are averaged to the nearest 0.1 pcf.

9.3.3

Remove all Sections of 9.3.3 – Alternate Method 3

10.1.1

Replace Section 10.1.1 – Percent Compaction:

The target HMA/SMA pavement density, determined to the nearest 0.1 lb/ft^3, is established using the mixture maximum specific gravity (Gmm) in the following equation:

$$Target\ Maximum\ Density = (Gmm) * 62.24\ \frac{lb}{ft^3}$$

Where, (Gmm) is determined from the applicable tables below. The Nuclear Gauge Gmm should be used for determining the target maximum density to be entered into the gauge for that day’s paving. The Correlation/Acceptance/Pay Gmm value will be determined at the end of that day’s paving and will be used to calculate nuclear gauge correlation offsets, final acceptance, and pay adjustment determination.

Test Strip Gmm for Target Maximum Density:

Test Strip Type	Gmm	
	Nuclear Gauge	Correlation/Acceptance/Pay
Density Test Strip with Simultaneous Volumetric Test Strip	JMF	Daily Average[1][2]
Density Test Strip with Separate Volumetric Test Strip	Average of two most recent tests	Daily Average[1][2]

[1] Subject to change based on the results of any required dispute resolution.

[2] The daily average can consist of one or more Gmm tests conducted on the day of paving.

Production Gmm for Target Maximum Density:

Quality Assurance Program	Phase	Gmm	
		Nuclear Gauge	Acceptance/Pay
QMP / PWL Lite	First Day of Production	JMF	Daily Average[1][2][3]
	All Other Days of Production	Average of two most recent tests	
PWL	First Day of Production		Daily Average[1][2][4]
	All Other Days of Production		

[1] The daily average can consist of one or more Gmm tests conducted on the day of paving.

[2] Subject to change based on the results of any required dispute resolution.

[3] If no Gmm tests were conducted for that day's paving (i.e.: small quantity paving), use the previous day's daily average Gmm or the JMF Gmm if it is the first day of production.

[4] If no Gmm tests were conducted for that day's paving (i.e.: small quantity paving), use the previous day's daily average Gmm.

11 *Replace all of Section 11 with the following:*

HMA/SMA Density Reporting:

The following data must be recorded daily on field project data sheets. These sheets will be made available to the project engineer upon request:

- Reference site block data
- Standard block data, including the density and moisture standard
- Density count, moisture counts or contact, and air gap counts

The following data must be recorded for each test on the worksheet for MRS entry:

- Density standard and moisture standard
- Density count, moisture counts or contact, and air gap counts
- Total wet density or bulk density
- Percent Compaction

	- Manufacturer name and serial number - Operators name - Mix design number (WisDOT 250 ID) and daily Target max density target number
Annex A	*Remove Annex A – (Wet) Density Calibration and Verification*
Annex B	*Remove Annex B – Water Content Calibration and Verification*
Appendix X1	*Replace Appendix X1 – Correlation with Cores with the following:* **WisDOT Procedure for Nuclear Gauge / Core Correlation – Test Strip**
X1.2.1	*Replace Section X1.2.1 with the following:* Determine the number and location of cores required for correlation according to WTP H-002, Section 3.1.
X1.2.2	*Replace Section X1.2.2 with the following:* **In-place densities using the nuclear gauge for each location:** Determine in-place densities using the nuclear density gauges for each location according to WTM T355 section 9.3.2. Take photos of each of the 10 core/gauge locations of the test strip. Include gauge readings (pcf) and a labelled core within the gauge footprint. If a third reading is needed, record and document all three readings. Only raw readings in pcf should be written on the pavement during the test strip, with a corresponding gauge ID/SN (generalized as QC-1 through QV-2 in the following Figure) in the following format:  Figure 1: Layout of raw gauge reading as recorded on pavement
X1.2.3	*Replace Section X1.2.3 with the following:* **Obtain a core from each of the locations:** The contractor is responsible for coring the pavement. Core the pavement according to WTM R67 from the footprint of the density tests under the supervision of a department representative. Fill core holes according to WTM R67 and obtain engineer approval before opening to traffic. Cores shall be cut by the next day after completion of the test strip, except if the next day is not a working day, then the cores shall be cut within 48 hours of placement. Each random core will be full thickness of the layer being placed. If a core is damaged at the time of coring, determine a new location for a replacement core 2-5 feet ahead (to avoid any water from the coring operation) of the existing testing location in the direction of traffic at

	the same offset as the damaged core. Both parties shall test the new location with the nuclear gauges prior to extracting the replacement core. **Note:** Coring after traffic is the on the pavement shall be avoided. The QV team is responsible for collecting, labeling, and safely transporting the cores from the field to the QC laboratory. The department representative will take custody of the cores until they are tested, whether that be immediately after the test strip or the following day if agreed upon between Department and Contractor. If a core is damaged during transport, record it as damaged and notify the engineer immediately.
X.1.2.4	*Replace Section X1.2.4 with the following:* **Test the cores:** The contractor, witnessed by department personnel, shall determine the bulk specific gravity (G_{mb}) according to WTM T166 for HMA cores and WTM T331 for SMA cores. The contractor shall dry the cores following testing according to WTM R79. The department will take possession of cores following the witnessed contractor testing and may perform verification testing at the discretion of the project engineer.
X.1.2.5	*Replace Section X1.2.5 with the following:* Determine the bulk density of the cores by multiplying G_{mb} by 62.24 lb/ft^3 and report the value to the nearest 0.1 lb/ft^3.
X1.3	*Replace Section 1.3, and all subsequent sections with the following:* Using the corresponding WisDOT spreadsheet, the engineer will analyze the readings of each gauge relative to the densities of the cores taken at each location. The engineer will determine the average difference between the nuclear gauge density readings and the measured core densities to be used as a constant offset value.
X1.4	*Remove section 1.4 – Core Correlation Example*

WTM D8159

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow ASTM D8159 ***Standard Method of Test for Automated Extraction of Asphalt Binder from Asphalt Mixtures*** with the following modifications:

<table>
<tr><th>ASTM D8159-19 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>1.4</td><td>*Remove section 1.4*</td></tr>
<tr><td>2.1</td><td>*Replace the ASTM D979/D979M, D1461, D5444 and AASHTO R47 references with the following WisDOT Modified versions:*
WTM R97 – Sampling HMA Mixtures
WTM T329 – Moisture Content of HMA Mixtures by Oven Method
WTM T30 – Mechanical Analysis of Extracted Aggregate
WTM R47 – Reducing Samples of HMA</td></tr>
<tr><td>7.2.1</td><td>*Replace the last sentence of Section 7.2.1 with the following:*
The HMA and RAP stockpile sample size shall be according to WTM R47 Section 14.0. RAS sample size shall be 500 grams.</td></tr>
<tr><td>Table 1</td><td>*Replace Table 1 with the following:*
<table>
<tr><th rowspan="3">Material</th><th rowspan="3">Maximum Basket Loading (grams)</th><th colspan="4">*Solvent Used*
Minimum[3] Number of Cycles</th></tr>
<tr><th colspan="2">*Trichlorethylene*</th><th colspan="2">*Methylene Chloride*</th></tr>
<tr><th>Wash</th><th>Dry</th><th>Wash</th><th>Dry[2]</th></tr>
<tr><td>37.5mm (No. 1)</td><td>2100[1]</td><td>15</td><td>6</td><td>12</td><td rowspan="8">See note 2 below</td></tr>
<tr><td>25.0mm (No.2)</td><td>1600[1]</td><td>12</td><td>6</td><td>10</td></tr>
<tr><td>19.0mm (No. 3)</td><td>2200</td><td>15</td><td>6</td><td>12</td></tr>
<tr><td>12.5mm (No. 4)</td><td>1700</td><td>12</td><td>6</td><td>10</td></tr>
<tr><td>9.5mm (No. 5)</td><td>1400</td><td>12</td><td>6</td><td>10</td></tr>
<tr><td>4.75mm (No. 6)</td><td>1400</td><td>12</td><td>6</td><td>10</td></tr>
<tr><td>RAP</td><td>1700</td><td>12</td><td>6</td><td>10</td></tr>
<tr><td>RAS</td><td>400</td><td>12</td><td>6</td><td>10</td></tr>
</table>
[1] Two extractions are required to obtain enough material for a proper test, per WTM R47
[2] Machines using Methylene Chloride must provide documentation verifying that the number of dry cycles used will result in a constant weight for each sample size according to Section 8.8.1 below. If no paperwork is provided, the samples must be dried to a constant mass using a 110 ± 5°C (230 ± 9°F) oven, measuring mass at 15-minute intervals until there is less than 0.1% mass loss.
[3] See Section 8.8.1 for alternatives</td></tr>
</table>

7.2.2	*Replace Section 7.2.2 with the following:* If the specimen was obtained from the field and contains moisture, oven dry the specimen to constant mass according to WTM T329.
8.7	*Replace Section 8.7 with the following:* Via the built-in HMI system, set the number of washing and drying cycles in accordance with Table 1 and Section 8.8.1.
8.8.1	*Replace Section 8.8.1 with the following:* Start the extraction process in accordance with manufacturer's instructions. Follow Table 1 for minimum wash and dry cycles. To reduce the minimum number of wash or dry cycles, provide the following paperwork upon request and include it in the lab calibration file. *Wash Cycles:* For each individual size (i.e. 12.5mm) to potentially modify, take a split sample and perform two extractions: (1) at the minimum wash cycles listed in Table 1, and (2) at a proposed number of wash cycles. If the asphalt contents are within 0.10% of each other, the new proposed was cycle is acceptable. Record the test data, file the paperwork. *Dry Cycles:* For each individual size (i.e. 12.5mm) to potentially modify, run a sample at the proposed number of dry cycles. After completing the proposed number of dry cycles, weigh and place the sample in a 110 ± 5°C (230 ± 9°F) oven. If after 15 minutes, there is less than 0.1% mass loss, the new proposed dry cycle is acceptable. Record the test data, file the paperwork.
Note 12	*Replace Note 12 with the following:* The duration of each washing cycle is determined by the manufacturer.

WTM D8225

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow ASTM D8225 ***Standard Method of Test for Determination of Cracking Tolerance Index of Asphalt Mixture Using the Indirect Tensile Cracking Test at Intermediate Temperature*** with the following modifications:

ASTM D8225-19 Section	WisDOT Modification:
2.1	*Replace the ASTM D3203/D3203M, D6925 and R30 references with the following reference:* WTM T269 – Percent Air Voids in Asphalt Mixtures WTM T312 – Superpave Gyratory Compactor WTM T30 – Mechanical Extraction of Aggregates *Remove ASTM D6925*
2.2	*Replace the AASHTO R30 reference with the following WisDOT Modified version:* WTM R30 – Mixture Conditioning of HMA
8.2.2	*Replace Section 8.2.2 with the following:* *Aging* – Laboratory-compacted (LMLC) mixes, specimens shall be properly conditioned before the compaction.
Note 2	*Replace Note 2 with the following* *Note 2* – For laboratory-mixed and laboratory-compacted (LMLC) mixes, condition specimens before compaction according to the short-term and long-term conditioning procedures specified in WTM R30. For plant-mixed and laboratory-compacted mixes (PMLC), condition specimens before compaction according to the long-term conditioning procedures specified in WTM R30.
8.2.3	*Replace Section 8.2.3 with the following:* *Air Void Content* – Prepare a minimum of three specimens at the target air void content 7.0 +/- 0.5%.
Note 3	*Replace Note 3 with the following:* Calculate the specimen air voids according to WTM T269.
9.1	*Replace Section 9.1 with the following:* Precondition test specimens in a water bath at a target intermediate test temperature 25°C (77°F) ± 1°C (± 2°F) for 2 h +/- 10 min.
Note 5	*Remove Note 5*

WisDOT Test Procedure (WTP) H-001

Effective with January 2025 Letting
Revised Date: 09/13/2023

WisDOT Test Procedure for HMA Mix Design Verification

This procedure is comprised of the steps required to verify an HMA mix design for use on WisDOT projects.

Section	WisDOT Procedure:
1	***Report Submittal and Department Review*** Mix design summary reports and either individual or batches of blended aggregates (if required or requested), are submitted to BTS before paving, using one of the following two methods: comparison level or express level. Each mix designer will be subject to a minimum of one comparison level submittal per year. In addition, mixes meeting the following criteria must have material submitted to BTS for comparison testing: • Design values for VMA (+0.5%). • FAA (+1.0%). • TSR are within +0.05 of the lower limit requirements in standard spec 460.2, table 460 - 2. The 10-day limit for comparison submittal does not apply. In addition to the above requirements for comparison mix design submittal, BTS requires submittal of BTS-selected mixes for performance-based testing. If BTS selects a mix design for both comparison and performance-based testing, the contractor must submit the following: • Only one batch of four 6800-gram specimens. • Asphalt binder in either three full 1-quart containers or one full 1-gallon container. • The number of TSR specimens the department requests. Each mix subject to this requirement will be determined by BTS and communicated to each mix designer. Designation of a design laboratory, or a certified mix designer to a specific submittal level is determined by the BTS. BTS will authorize and direct movement between submittal levels. Submittals received after 4pm (Mon-Fri) will be acknowledged as arriving the following work day. Each design must be submitted using the WisDOT Mix Design Standard Data Input Form/Report 249 through WisDOT Material Reporting System (MRS). The contractor must provide electronic notification to BTS and the regional HMA Specialist when Form/Report 249 is submitted.

Only one mix design per email notification will be accepted.

At BTS's discretion, any or all of the following testing may be performed.
Aggregates:

- Test the aggregate for compliance to standard spec 460.2, table 460-2:
- Flat and elongated (Method B), %.
- Coarse fracture/crush count (1-face and 2-face), %.
- Sand equivalency.
- Fine aggregate angularity (Method A)[1].
- Moisture absorption %.
- Bulk specific gravity (Gsb)[1].

[1] FAA and Gsb need to meet tolerances in the table below, compared to results provided on original Mix Design submittal.

HMA:

Test the HMA for compliance to standard spec 460.2, tables 460-1 and 460-2.

Allowable Differences between Contractor and BTS Comparison Test Results

Test	Test Allowable Difference
Mixture bulk specific gravity (Gmb) [1]	+/- 0.030
Mixture maximum specific gravity (Gmm) [1]	+/- 0.020
Fine Aggregate Angularity (Method A), uncompact voids (%)	- 1
Aggregate Individual Bulk Specific Gravity (+No. 4 [+4.75mm]) (Dry)	+/- 0.0°
Aggregate Individual Bulk Specific Gravity (-No. 4 [-4.75mm]) (Dry)	+/- 0.032

[1] The allowable difference is compared to results provided on original mix design submittal.

Individual component aggregates may be tested. Communication between BTS and the mix designer must take place before requesting materials.

If BTS's test results are less than the values in standard spec 460.2, table 460-2 for minimum TSR values, the mix may need to be redesigned and tested, also all future submittals using this source may require the submission of TSR samples for verification/acceptance testing until BTS is satisfied with the source. Communication with BTS is required and all testing is at the discretion of BTS.

The department can reject a superpave mix design, or stop the review, for reasons including but not limited to the following:

- Evaluation of a superpave mix design results indicate a failing design.
- Incorrect or insufficient submittals.
- Incomplete documentation.
- Aggregate physical requirements do not meet standard spec 460.2, table 460-2.
- The contractor/consultant requested combined gradation does not meet standard spec 460.2, table 460-1.

- No office notification of comparison level samples being sent to BTS office.
- Invalid aggregate quality number.
- Contractor/consultant suspends interest in submitted material.

Subject to BTS workload and after the contractor/consultant efforts are made to resolve all discrepancies in the submittal, BTS may resume the ten-day review procedure.

2 ***Comparison Level Submittals***

This process requires submittal of the mix design summary report and blended aggregates representing the mix design job mix formula (JMF). The contractor needs to submit materials to the department a minimum of 10 working days before paving.

- The contractor must include four 6800 g (15 lb) batches of the blended aggregate, representing the mix design JMF, (inclusive of any components containing recycled asphaltic materials or stabilizing agents) and either three full 1-quart containers or one full 1-gallon container of design PG binder. Virgin blended aggregate is submitted separately from RAM and both must be dried before sending to BTS.
- BTS may request individual aggregate/RAM samples for each component and either three full 1-quart containers or one full 1-gallon container of the design PG binder in place of the composite aggregate samples.

If TSR's are requested, the contractor will supply 8 compacted specimens to BTS. Compact specimens to 7.0 +/- 0.5% air voids, or for SMA mixtures, to 7.0 +/- 1.0% air voids.

The following conditions indicate a need to follow this submittal procedure (communication with BTS is required):

1. Any design laboratory or certified asphalt mix designer submitting designs to the BTS for the first time (regardless of previous history for either).
2. Any design laboratory or certified asphalt mix designer having lacked submittals for a period of three consecutive construction seasons.
3. Any design laboratory or mix designer abusing the "express submittal" privilege (ex: multiple instances of incorrect or non-compliant data/information needing correction or formal amendment). Note: This condition will be identified and communicated when trending and then defined by notification from the BTS.

Transition from "comparison level" submittal requirements to "express submittals" will be by notification from BTS.

Results of the comparison review must be compared. When tolerances are exceeded in table 866-3 or if the results are less than the requirements in standard spec 460.2, tables 460-1 and 460-2, a new mix design may need to be completed and submitted by the contractor/consultant.

3 ***Express Submittal***

Design laboratories or certified designers may use this submittal procedure with authorization from BTS.

The design laboratory must submit the mix design summary report (electronically) to the department for review and provide a copy to the department's regional office a minimum of 4 working days before the start of paving.

1. The department will review the mix design summary report and acknowledge specification compliance by the following 4th work day after submittal.

In the event that the submitted design does not meet specifications, or the individual contract requirements, the department will notify the mix designer and may elect to delay release of the review (potentially impacting paving); until such time that the specifications are met.

HTCP-Certified Hot Mix Asphalt, Mix Design, Report Submittals (HMA-MD) technicians requesting mix design comparison testing should follow the requirements for "Comparison Level" submittals and alert the BTS Truax Center Laboratory of the request to have properties checked. Use of this submittal procedure, while authorized for Express Level, does not negate further use of Express Level submittals.

4

Mixture Design Life

All HMA mix designs have a life of 3-years from the date of the initial assigned WisDOT 250 number.

Count the current construction season as year one of mix design life eligibility. For any mix design to surpass the 3-year life, a one-point verification using lab or field produced materials is required as described in 866.1. One-point verifications are to be conducted on the current JMF blend (including all current approved JMF changes) and %AC corresponding to 4.0% air voids using Ndes gyrations for lab-batched material and at % AC corresponding to 3.0% air voids for plant produced material. This allows for plant-produced mix to be used for one-point verification. If plant-produced mix is used for one-point verification it will be produced within 10 days of submittal, unless otherwise approved by BTS. In addition to the current JMF blend, the most recent control charts will be submitted to BTS for one-point verification. Results must be submitted electronically to BTS - Truax for review along with the current mix design including any current approved JMF changes. Individual specific gravities must not vary more than the allowable differences in table 866-4.

BTS will review the submitted data with-in 4 (four) working days and if compliant the mix will be put on the approved HMA Mix Design List for another 3-year cycle. BTS will review the results to verify they conform to the requirements listed in standard spec 460.2, tables 460-1 & 460-2.

The percent binder replacement (Pbr) in standard spec 460.2.5 must also be verified and reported to show results are within allowable tolerances. Note: The tolerances in table 866-4 are used to evaluate the one-point verification test results.

Previously approved mix designs not meeting the requirements of the Air Void Regression specification (i.e., having a point ≤3.0% Air Voids), require an additional point be run at the next lower 0.5% AC increment. In this instance, mixes are to be entered into MRS using the 249 form and will be assigned a new 250#. The previously assigned 250# number associated with the mix (before conducting the next lower 0.5% AC increment) will become inactive.

Allowable Differences for One-Point Verification Check Test Results

HMA	Allowable Difference
Air Voids (Va) %	+/- 0.5
Aggregates	Allowable Difference
Aggregate Individual Bulk Specific Gravity (+No. 4 [+4.75mm]) (Dry)	+/- 0.025
Aggregate Individual Bulk Specific Gravity (-No. 4 [-4.75mm]) (Dry)	+/- 0.032

Mix designs carry over for subsequent construction seasons, with-in the 3-year design life, when all of the following are met:

1. Department specification changes have occurred, and the mix design still meets those specifications for any current contract.
2. Aggregate quality data is current as specified in standard spec 106.3.4.2.2.1. See department 162 and 225 reports for approved aggregate sources on the APL.
3. Design aggregate component blend percentages will not be changed by more than 20% in any combination at any single point during production.
    a. Note that any single component blend adjustment will result in a need to adjust additional components to balance the blend (e.g.: any component adjusted by 10% will also require an additional "other" 10% change between the remaining components, resulting in the maximum 20% referenced change). However, component blend changes are not accumulative so component blend changes back towards the original JMF will not be considered as exceeding the 20% maximum. The following example illustrates changes to proportions and how to assess blend changes:
        i. For example, if the original proportions for the aggregates are: Agg1 = 25%, Agg2 = 25%, Agg3 = 45%, Agg4 = 5%. Then the initial component blend first changes by adjusting Agg1 to 35% and Agg2 to 15% resulting in a 20% change from the JMF. Then a second change had Agg1 moved back towards the original JMF to 30% and changed Agg2 to 20% resulting in a 10% net change from the original JMF. The second change does not get added to the first change of 20%. Each change is independently assessed against the original JMF, not added to other previous changes.

	b. Blend changes indicating an excess of the maximum 20% away from the original JMF will not be considered the same mix design within the same season or any subsequent season. Continued use will require a new mix design or approval of the project engineer (documenting the reason). Any need for elimination or addition of new aggregate (inclusive of RAM) components requires a new mix design. Additives including a change in the dosage rates may require additional testing to insure compliance. Recognizing all current design JMF target changes with associated QMP data from the end of the previous construction season is required and must be noted "as such" before initial paving. A current list of approved asphalt mix designs is located on the APL.

WisDOT Test Procedure (WTP) H-002

Effective with January 2025 Letting
Revised Date: 12/02/2024

WisDOT Test Procedure for HMA Density Sublot Layout

This procedure is comprised of the steps to calculate and lay out lots for HMA Nuclear Density testing.

Section	WisDOT Procedure:
1	***Sublots*** Sublots are determined for each layer and target density. When determining sublots, a paved lane refers to a traffic lane, shoulder, or a single pass of the paver, whichever is smaller. All sublots will be laid out by the linear sublot system. A sublot may include more than one day's paving. It is not required to take an additional non-random test if a sublot spans more than one day's paving. Sublot names should progress in the order of increasing mainline stationing within the project. Two methods for determining sublot layouts and test locations will be used depending on the geometry of the pavement and the density Quality Assurance Program. • Layouts based on a single paved lane: mainline paving, shoulders, turn lanes, crossovers, ramps, and roundabouts. • Layouts based on multiple paved lanes within a contiguous pavement area: side roads, intersections, and appurtenances. Section 2 covers sublot layouts used for QMP and Department Acceptance Quality Assurance Programs, while section 3 covers sublot layouts used for Percent within Limits (PWL). For all QMP and PWL projects, sublot names and locations must be determined by the contractor and provided to the QV team for all planned paving before project start-up. The QV team will use the same sublot names and locations as the contractor. For layout based on the multiple paved lanes within a contiguous pavement area, sublots may be adjusted in the field based on actual paved areas as determined by the engineer. ***Location of Random Test Sites*** The specifications require each lot to be sampled at random locations. Random locations are determined independently for each lane or shoulder sublot. The centerline is used as the reference line to determine offset (identify either right or left of centerline). Locations of test sites must be determined randomly using WTM D3665.

2 *Layouts for QMP or Department Acceptance*

A lot is one day's production of each sublot type or one production shift if running 24 hours per day. Sublots are determined for each layer and target density. A typical sublot is defined as 1,500 lane feet.

Layouts based on single paved lanes should be used for sublots oriented parallel to the primary paving project. This typically includes mainline paving, shoulders, turn lanes, crossovers, ramps, and roundabouts. Segmented, staged work with variable widths may require some adjustment to testing locations during construction.

Layouts based on multiple paved lanes within a contiguous pavement area should be used for sublots oriented approximately perpendicular to the primary paving project. This typically includes intersections, side roads, and appurtenances.

For any single paved lane less than 50 feet, testing may be waived by the department, and the material will be accepted by ordinary compaction according to standard spec 450.3.2.6.2.

2.1 *Single Paved Lane greater than or equal to 1,500 feet*

Sublots are divided into equal widths according to Table 1 with the number of tests and offset widths per sublot determined by the lane width at the widest location. At the end of paving, partial sublots less than 750 lane feet are included with the previous sublot and those greater than or equal to 750 lane feet constitute their own sublot. Figures 1 and 2 show example testing layouts of single paved lanes greater than or equal to 1,500 feet for full-width and tapered pavement.

Steps for determining test locations:

Step 1: Using Table 1, determine the number of tests and offset widths required in each sublot, depending on the lane width. The offset width is determined by dividing the lane width by the required number of tests in the sublot.

Step 2: Determine random stations for each test in the sublot. The sublot random test stations are computed by multiplying the entire sublot length by a random number determined according to WTM D3665 and adding the result to the beginning station of the sublot.

Step 3: Determine the test site offsets. The random transverse locations are computed for each test site by multiplying the offset width by a random number determined according to WTM D3665 and adding the result to the beginning of the corresponding offset range.

Table 1 ***Required tests by lane width for single paved lanes greater than or equal to 1,500 feet***

Lane / Shoulder Width (W)	No. of Tests	Transverse Location
W ≤ 5 feet[1]	1	Random
5 feet < W ≤ 9 feet	2	Random within 2 equal widths
W > 9 feet	3	Random within 3 equal widths

[1] Minimum shoulder width 2 feet.

Figure 1

Layout for Full Width Single Paved Lane greater than or equal to 1,500 feet

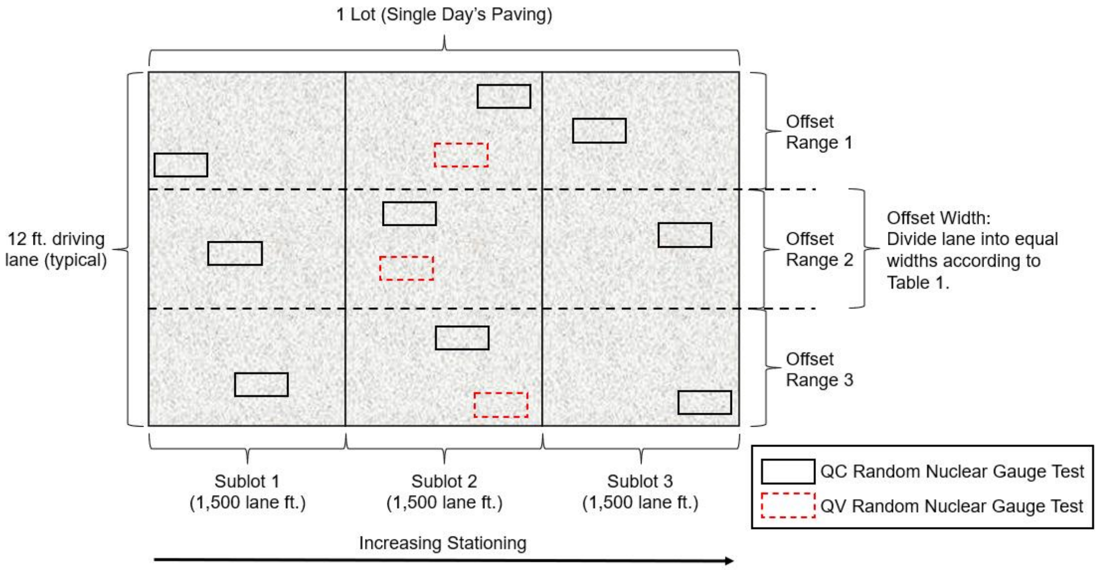
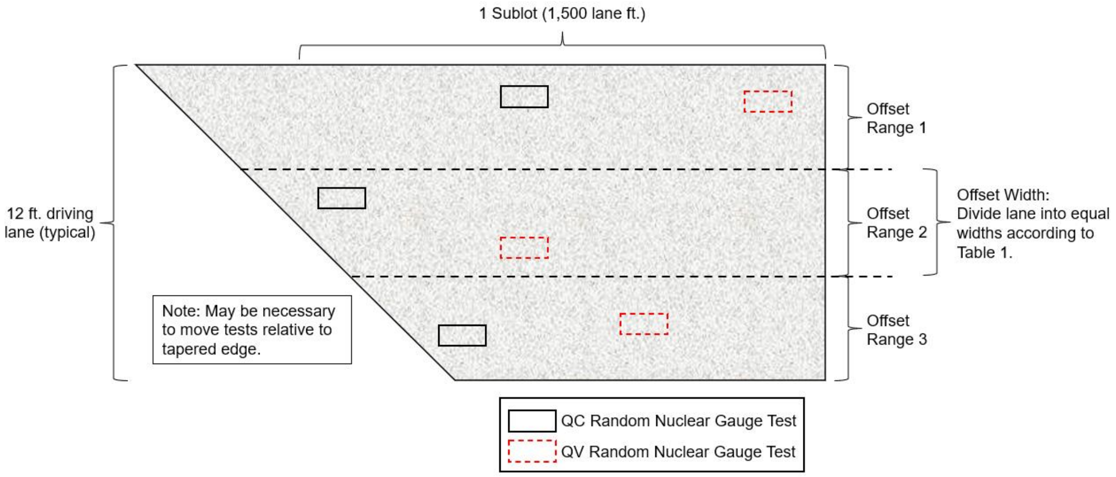


Figure 2

Example Layout for Tapered Single Paved Lane greater than or equal to 1,500 feet



2.2 Single Paved Lane less than 1,500 feet

Single paved lanes less than 1,500 lane feet are divided into equal length segments according to Table 2 with the number of tests and segments per sublot determined by the paved lane length at the longest location. A minimum of 1 sublot is required per single paved lane. Figure 3 shows an example layout for a tapered single paved lane less than 1,500 feet.

Steps for determining test locations:

Step 1: Using Table 2, determine the number of tests and equal segments required in each sublot, depending on the lane length. Equal segment lengths are determined by dividing the total sublot length by the required number of tests.

Step 2: Determine a random station for each test in each sublot. The sublot random test stations are computed by multiplying the length of each segment by a random number determined according to WTM D3665 and adding the result to the beginning station of the segment.

Step 3: Determine the test site offsets. A random transverse offset is computed for each test site by multiplying the entire lane width by a random number determined according to WTM D3665 and using the result to determine the distance from the reference line.

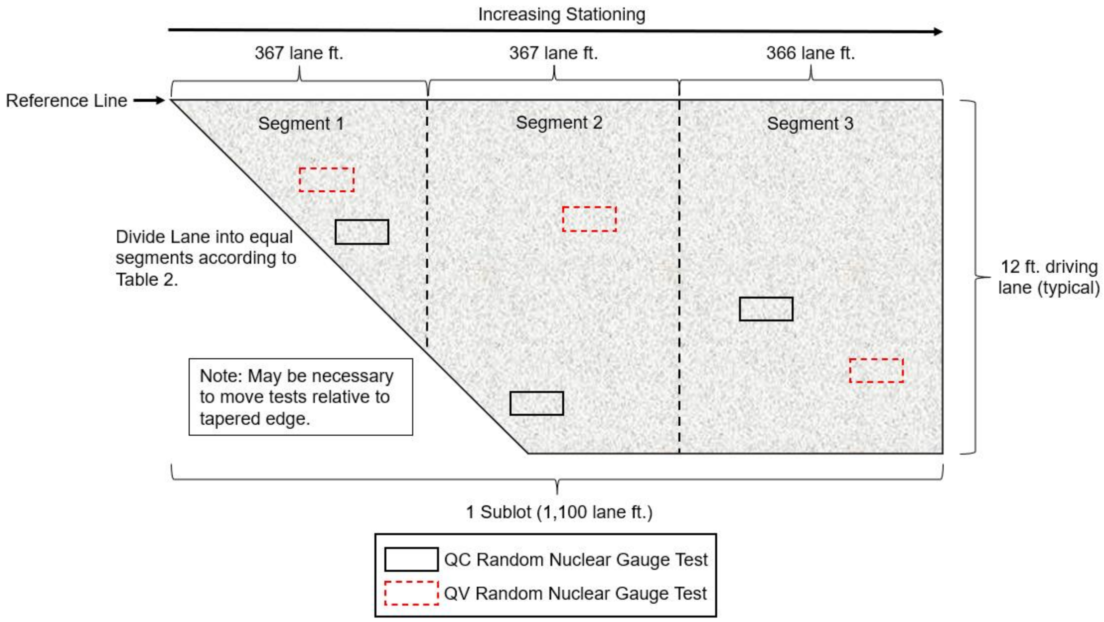
Table 2

Required tests by lane length for single paved lanes less than 1,500 feet

Lane Length (L)	**No. of Tests**	**Longitudinal Location**
L ≤ 500 feet	1	Random
500 feet < L ≤ 999 feet	2	Random within 2 equal segments
999 feet < L ≤ 1,499 feet	3	Random within 3 equal segments

Figure 3

Example Layout for Tapered Pavement with Single Paved Lane less than 1,500 feet



2.3 ***Layout Based on Multiple Paved Lanes Within a Continuous Pavement Area***

Unless the engineer directs otherwise, the shoulders of intersections, side roads, and appurtenances are tested with the traffic lanes. For intersections, side roads, and appurtenances with single paved lanes greater than or equal to 1,500 feet, shoulders will be separated from the traffic lanes for density testing according to Section 2.1.

Steps for determining test locations:

Step 1: Divide the contiguous pavement area up into segments of equal length paved lanes. Segments (i.e.: Segment 1, Segment 2,…) should be laid out such that they increment in the direction of the increasing stationing of the primary paving project. Sum the length of the segments within the contiguous pavement area. Determine the number of tests using the total length of the segments according to Table 2. If the total length of the segments within the contiguous area is greater than 1,500 feet, add 1 additional test for each additional 500 lane feet or portion thereof up to 2,250 feet total. For total lane feet within the contiguous area greater than 2,250 feet, additional sublots are required.

Step 2: Determine a random station for each test in each sublot.

Case 1: Equal Number of Segments and Required Tests (Figure 4)

The sublot random test stations are computed by multiplying the length of each segment by a random number determined according to WTM D3665 and adding the result to the beginning station of the segment.

Case 2: More or Less Segments than Number of Required Tests (Figure 5 and 6)

For contiguous pavement areas that result in more or less segments than required tests for the cumulative paved lane lengths, treat the segments as one continuous linear segment when determining longitudinal test stations (Stationing for subsequent segments should continue to increment from the end of the previous segment, rather than restart at the beginning station). The sublot random test stations are computed by summing the length of all the segments within the contiguous paving area, and multiplying the total segment length by a random number determined according to WTM D3665 and adding the result to the beginning station of the first segment.

Step 3: Determine the test site offsets.

A random transverse offset is computed for each station by multiplying the lane width of the segment by a random number determined according to WTM D3665. The test site is offset by the computed distance relative to the reference line.

Figure 4 ***Example Layout for Multiple Paved Lanes Within a Contiguous Pavement Area – Equal Number of Segments and Required Tests***

Step 1:
The contiguous paving area is made up of two paved lanes. These individual paved lanes constitute segments 1 and 2.

The sum of the lengths of both segments is 840 ft.
(2 segments x 420 ft.)

From Table 2, two tests are required.

Step 2:
Since there are an equal number of segments (2) and required tests (2), one random longitudinal station is required within each segment for a total of 2 stations, one in each segment.

Step 3:
Offsets are determined for each longitudinal station in each segment by multiplying a random number by the width of each segment (12 ft.).

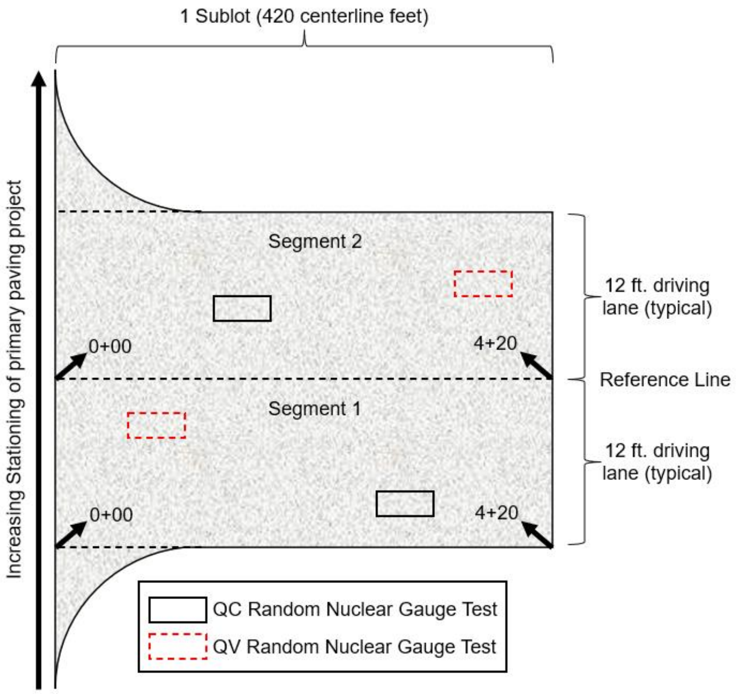


Figure 5 ***Example Layout for Multiple Paved Lanes Within a Contiguous Pavement Area – More Segments than Required Tests***

Step 1:
The contiguous paving area is made up of two paved lanes. These individual paved lanes constitute segments 1 and 2.

The sum of the lengths of both segments is 300 ft.
(2 segments x 150 ft.)

From Table 2, one test is required.

Step 2:
Since there are more segments (2) than required tests (1), treat both segments as one long continuous segment when determining random longitudinal stations.

Step 3:
The offset is determined in the respective segment by multiplying a random number by the width of the segment (12 ft.).

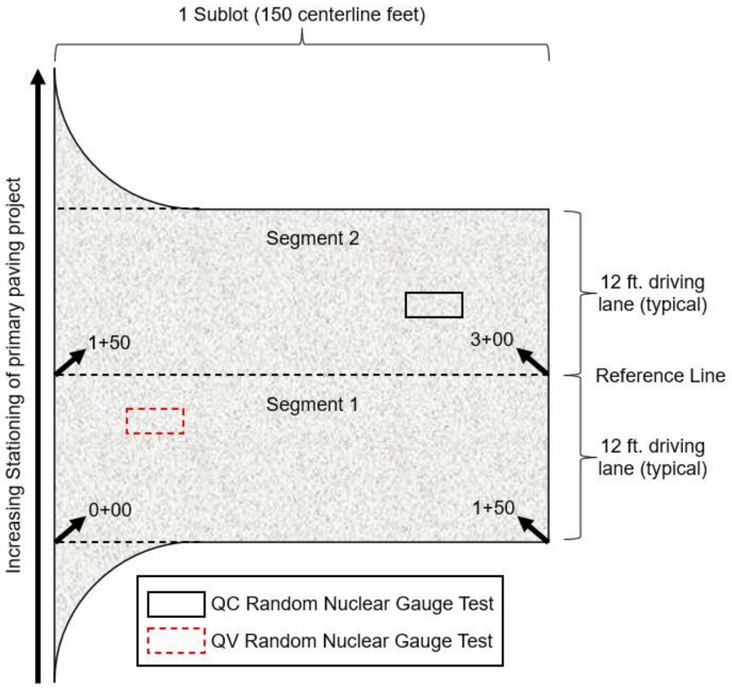


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Figure 6

Example Layout for Multiple Paved Lanes Within a Contiguous Pavement Area – Less Segments than Required Tests

Step 1:
The contiguous paving area is made up of three paved lanes. These individual paved lanes constitute segments 1, 2, and 3.

The sum of the lengths of the segments is 1,800 ft.
(3 segments x 600 ft.)

Since the total length is greater than 1,500 ft. three tests are required plus an additional test for every 500 ft. or portion thereof over 1,500 ft. Therefore, the total number of required tests is four.

Step 2:
Since there are less segments (3) than required tests (4), one random station is required within each segment, resulting in three random stations. To determine the fourth random station, treat all three segments as a single continuous segment and select a random station along the combined length.

Step 3:
The offset is determined in the respective segment by multiplying a random number by the width of the segment (12 ft.).

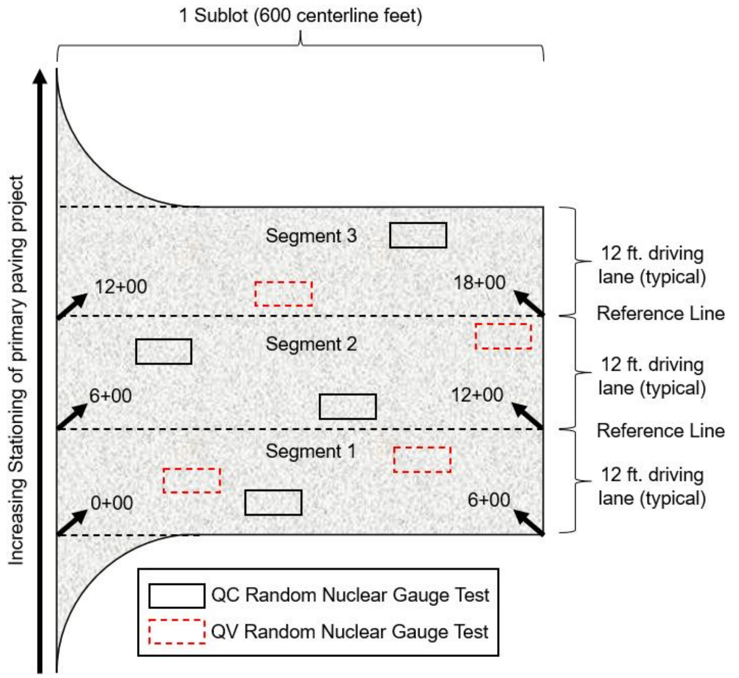
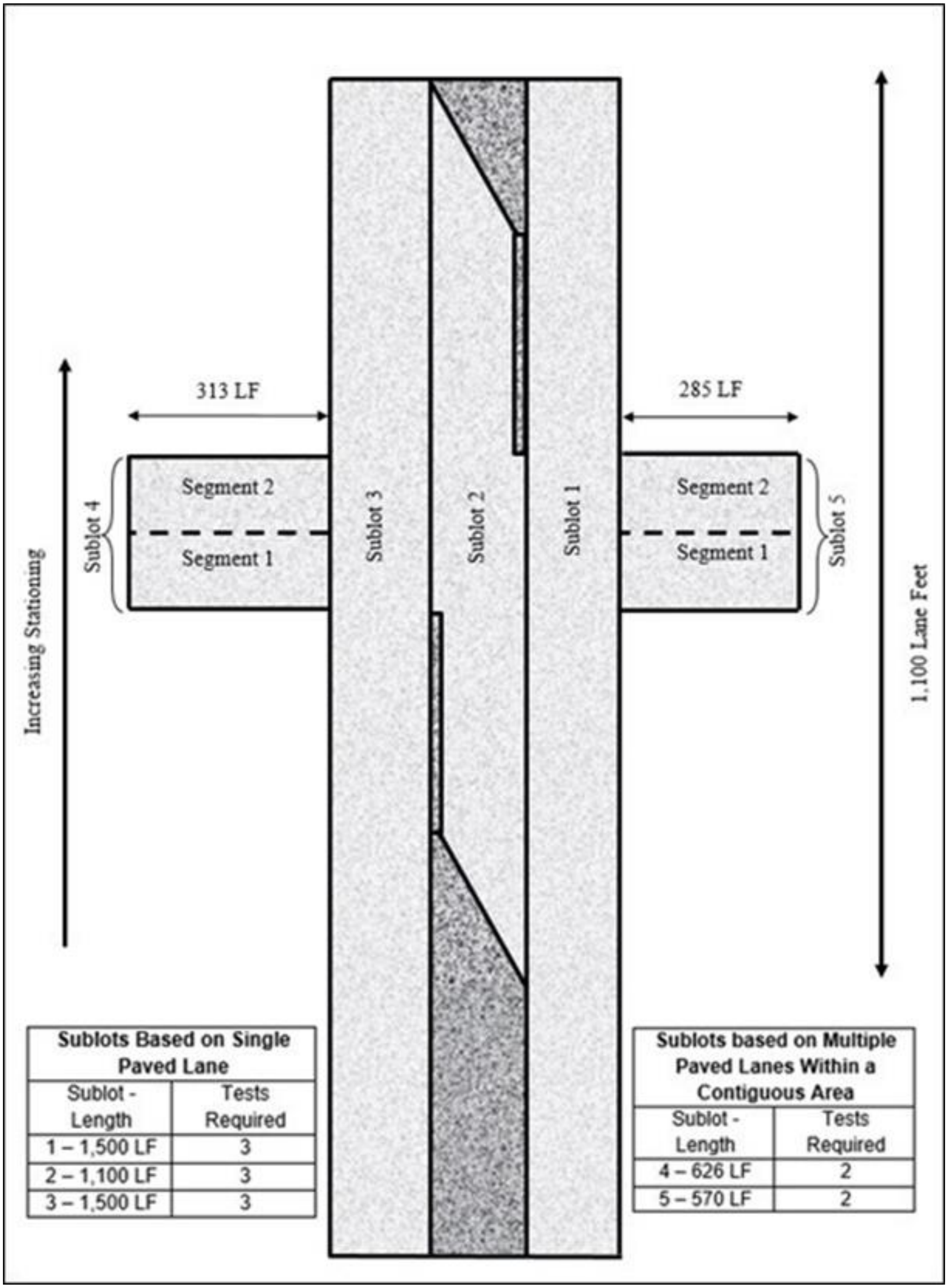


Figure 7

Example Sublot Layout for Intersections (All Three Layout Concepts from Section 2)

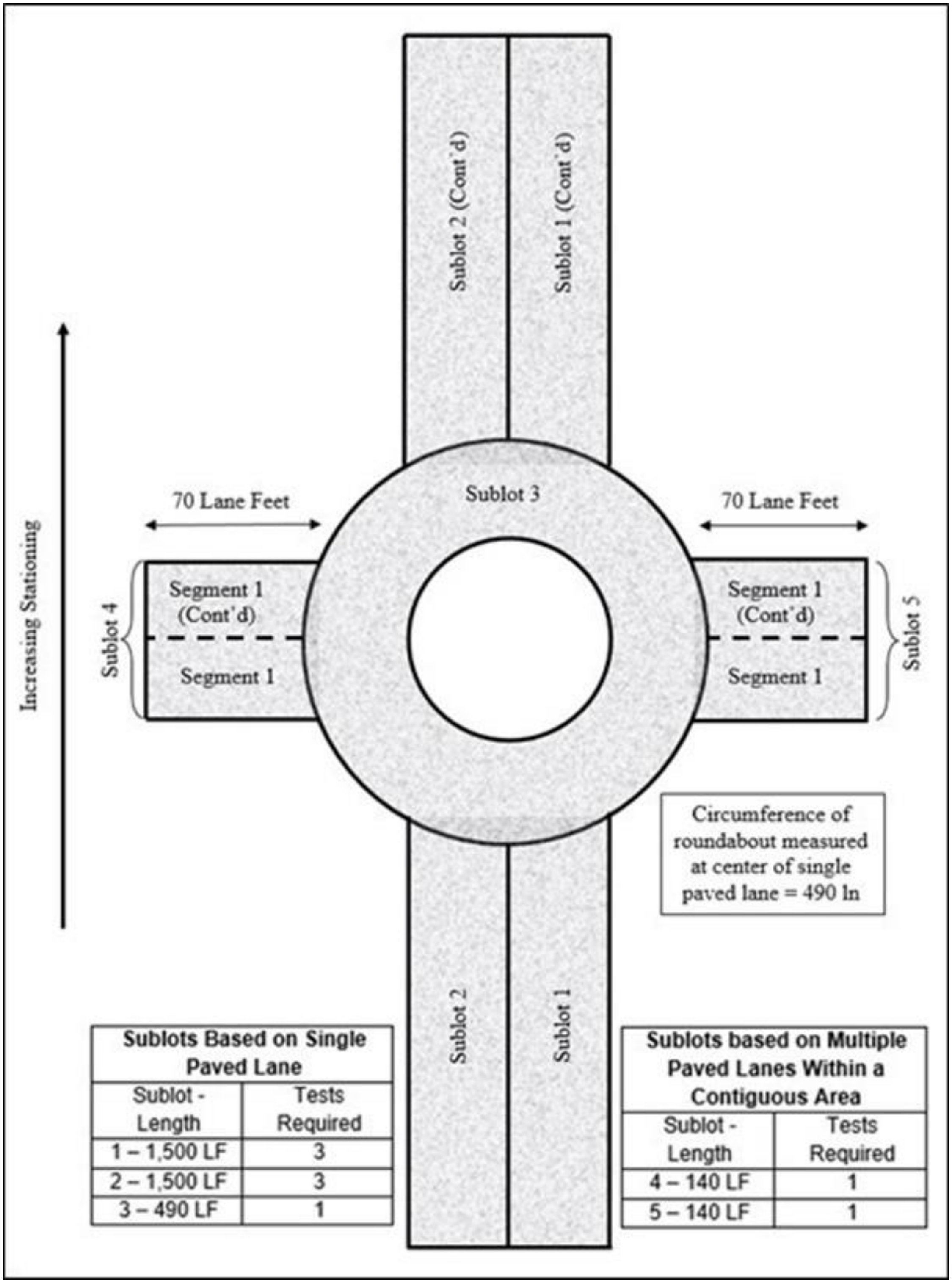


Sublots Based on Single Paved Lane	
Sublot - Length	Tests Required
1 – 1,500 LF	3
2 – 1,100 LF	3
3 – 1,500 LF	3

Sublots based on Multiple Paved Lanes Within a Contiguous Area	
Sublot - Length	Tests Required
4 – 626 LF	2
5 – 570 LF	2

Figure 8

Example Sublot Layout for Roundabouts (All Three Layout Concepts from Section 2)



Circumference of roundabout measured at center of single paved lane = 490 ln

Sublots Based on Single Paved Lane	
Sublot - Length	Tests Required
1 – 1,500 LF	3
2 – 1,500 LF	3
3 – 490 LF	1

Sublots based on Multiple Paved Lanes Within a Contiguous Area	
Sublot - Length	Tests Required
4 – 140 LF	1
5 – 140 LF	1

3 *Layouts for Percent within Limits (PWL)*

A lot is defined as 7,500 lane feet with sublots of 1,500 lane feet and placed within a single layer for each location and target maximum density category. A partial quantity less than 750 lane feet will be included with the previous sublot. Partial lots with less than three sublots will be included in the previous lot for data analysis/acceptance and pay.

Layouts based on single paved lanes should be used for PWL sublots. These layouts only apply to the traffic lanes. Shoulders are not included, even if paved integrally. Shoulders on PWL projects are accepted by Department Acceptance and use the applicable layouts from section 2.

3.1 *Percent within Limits Density Test Strip*

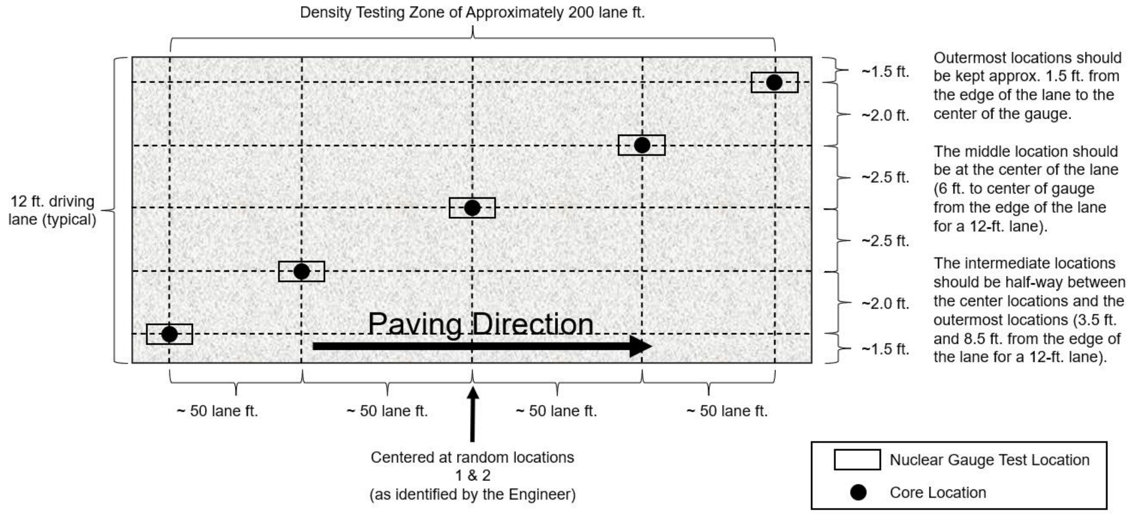
A Density Test Strip typically is the resulting length of 750 tons of material. The resulting length of a Density Test Strip varies and depends on the width and thickness of the layer.

Steps for determining test locations:

Step 1: The engineer will identify two zones in which gauge/core correlation is to be performed. These two zones will be randomly selected within each half of the test strip length. Density zones shall not overlap and must have a minimum of 100 feet between the two zones.

Step 2: Each zone shall consist of five locations across the mat as identified in Figure 9. Sites are staggered across the travel lane, and do not include shoulders. The outermost locations shall be 1.5-feet from the center of the gauge/core to the edge of the lane. The middle location should be at the center of the lane (typically 6-feet from the edge of a 12-foot lane to the center of the gauge/core). The intermediate locations should be half-way between the center location and the outermost locations (approximately 3.5-feet and 8.5-feet from the edge of a 12-foot lane, respectively). The zones are supposed to be undisclosed to the contractor/roller operators. The engineer will not lay out density/core test sites until rolling is completed and the cold/finish roller is beyond the entirety of the zone.

Figure 9 ***Example Layout for PWL Density Test Strip***



3.2

Percent within Limits Mainline

There are two methods for laying out sublots for PWL depending on the method of acceptance – nuclear gauges or cores.

Nuclear Gauge - Steps for determining test locations (Figure 10):

Step 1: Sublots are broken down into three equal widths per sublot representing the outside, middle, and inside of the paving lane (i.e., the lane width will be divided into thirds as shown by the dashed longitudinal lines in Figure 10).

Step 2: QC will select three random numbers determined according to WTM D3665 to be used to identify the specific transverse location within each equal width.

QV will select one random number determined according to WTM D3665 to be used to identify the specific transverse location within the entire width of the sublot.

Step 3: Longitudinal locations within each sublot shall be determined with random numbers determined according to WTM D3665.

Cores - Steps for determining test locations (Figure 11):

Note: The contractor may layout the density sublots for coring, however the random test locations within the sublots must be determined by the QV.

Step 1: QV will select one random number determined according to WTM D3665 to be used to identify the specific transverse location within the entire width of the sublot.

Step 2: QV will determine the longitudinal location within each sublot with independent random numbers determined according to WTM D3665.

Figure 10

Example Layout for PWL Mainline – Nuclear Gauge

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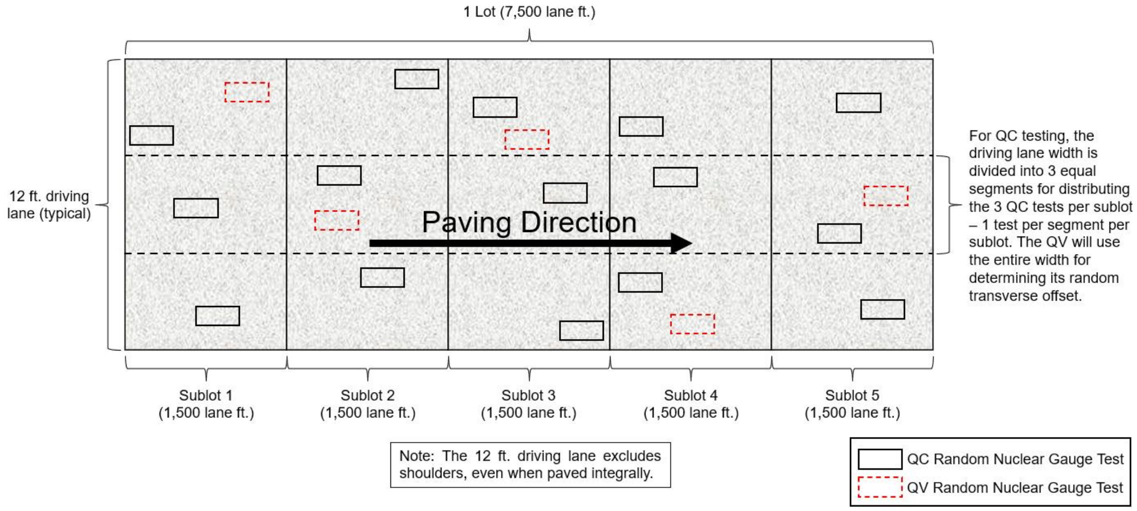
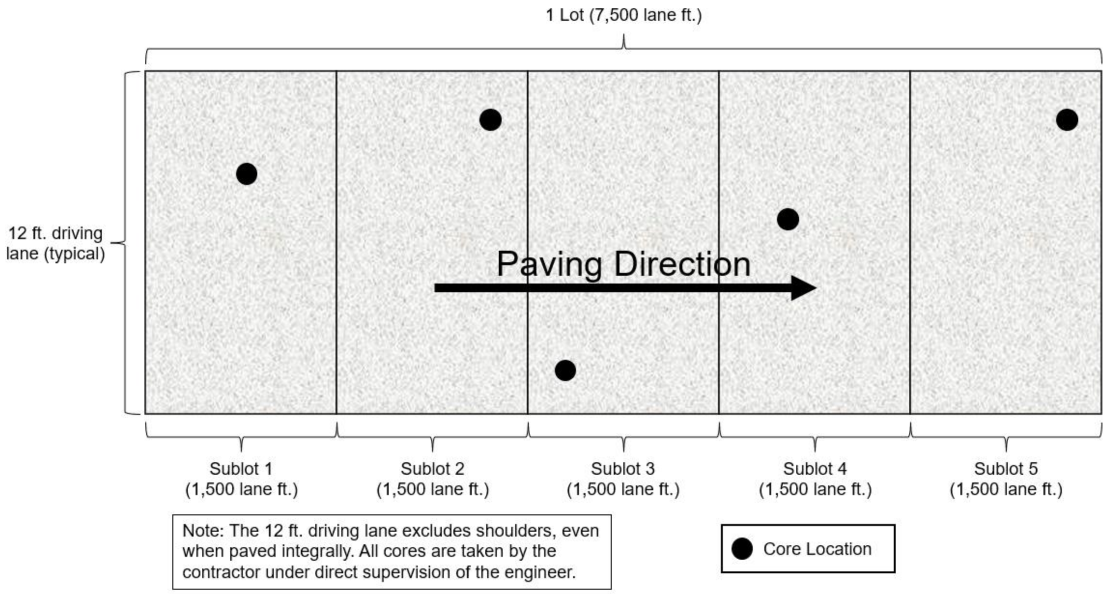


For QC testing, the driving lane width is divided into 3 equal segments for distributing the 3 QC tests per sublot – 1 test per segment per sublot. The QV will use the entire width for determining its random transverse offset.

Note: The 12 ft. driving lane excludes shoulders, even when paved integrally.

Figure 11

Example Layout for PWL Mainline – Cores



Note: The 12 ft. driving lane excludes shoulders, even when paved integrally. All cores are taken by the contractor under direct supervision of the engineer.

3.3 *Layout for Longitudinal Joints*

For PWL projects, each QC and QV density location must have a companion density location at any applicable joint.

Steps for determining test locations:

Step 1: This companion location must share longitudinal stationing with each mainline QC or QV density location.

Step 2: The companion location must be located transversely with the center of the gauge/core 6-inches from the edge of the paving area.

Figure 12 shows an example of sublot layouts when using a nuclear gauge, while Figure 13 shows an example of sublot layouts when using cores.

Figure 12

Example Layout for Longitudinal Joints – Nuclear Gauge

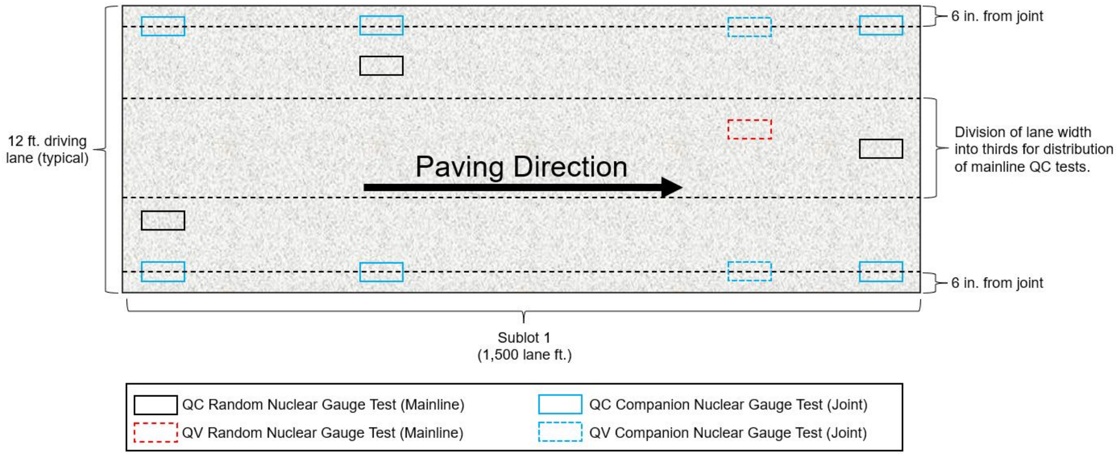
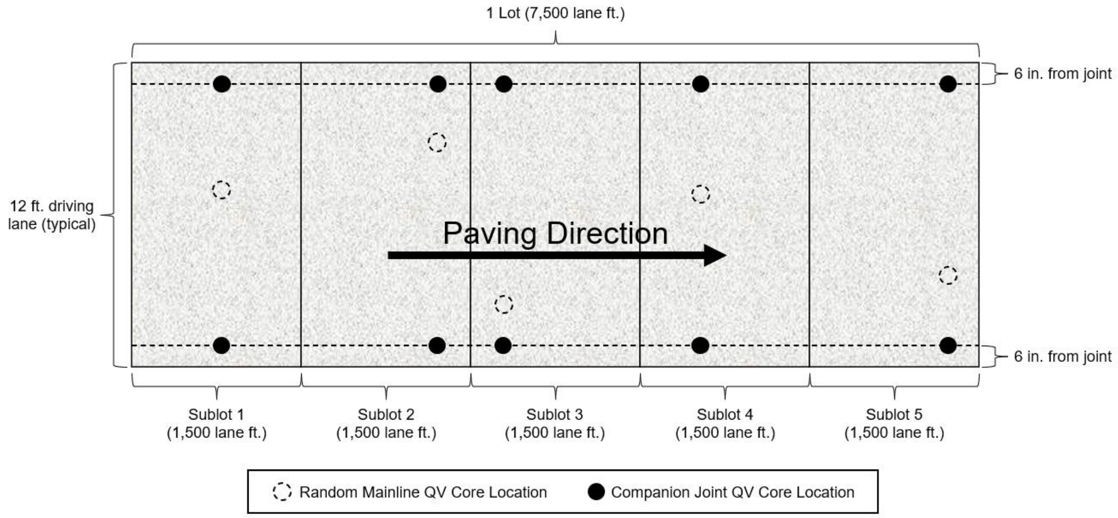


Figure 13

Example Layout for Longitudinal Joints – Cores



WisDOT Test Procedure (WTP) H-003

Effective with January 2025 Letting
Revised Date: 09/13/2023

WisDOT Test Procedure for Ignition Oven Correction Factor

This procedure is comprised of the steps to determine the ignition oven correction factor for HMA when performing WTM T308.

Section | **WisDOT Procedure:**

1 *General*

Ignition ovens used for AC determination should be installed, operated, and maintained according to AASHTO R96. Mix designs with AC determined by ignition oven must have appropriate ignition oven correction factors (IOCF). Ignition oven asphalt binder content and aggregate correction factors are specific to each mix design and oven and are not transferable.

2 *Initial Ignition Oven Correction Factor Determinations*

Mix designers collect and furnish lab-batched material, at 3.0% air voids for HMA or 4.5% air voids for SMA, to provide the region with ten individually packaged IOCF split samples of appropriate weight according to table Table 1 below at least 10 days before producing the mix design on a WisDOT contract. Regional labs send three individually packaged IOCF split samples to a department lab within one day of receiving them for asphalt binder content determination by automated extraction.

Table 1 - Minimum IOCF Sample Weight

Nominal Max Aggregate Size (mm)	Individually-Packed IOCF Sample Minimum Weight (grams)[1]
37.5mm (No. 1)	4000 Grams
25.0mm (No. 2)	3000 Grams
19.0mm (No. 3)	2000 Grams
12.5mm (No. 4)	1500 Grams
9.5mm (No. 5)	1000 Grams
4.75mm (No. 6)	1000 Grams

[1] IOCF samples must be no more than 500 grams greater than the minimum weight provided.

Label the following information on each individually packaged IOCF sample:

1. Contractor testing lab and certified technician name.
2. Date.
3. Type of asphaltic mixture.
4. Lab-batched or field produced material.
5. Contractor's mix ID for lab batched or WisDOT ID (250-XXXX-YR) for plant-produced.
6. Percent binder, virgin aggregate, and RAM.
7. Reason for submittal, choose one of the below:
    - New design.
    - Reverification, listing a reason from Table 2.

Table 2 – Reasons to Reverify the IOCF

1. Annual mix reverification.
2. Exceed 50,000 tons of mixture produced since last IOCF determination/reverification.
3. An individual aggregate, virgin or RAP, changes by more than 5% from the JMF or current IOCF.
4. Percentage of RAS is changed.
5. Equipment is changed, replaced, or recalibrated.
6. The department questions their own IOCF.
7. The contractor questions the accuracy of their own IOCF.

Both the contractor and regional lab independently determine an ignition oven asphalt binder correction factor and the contractor must determine the appropriate aggregate correction factor for each mix design and oven according to WTM T308 Section A. Contractors must determine their IOCFs before the first day of production. The contractor must note on the percent binder control charts the IOCF and the date the IOCF became effective. The department verifies the asphalt content for each split sample provided to the regional lab using automated extraction according to WTM D8159.

The contractor may compare their ignition oven results to the region's by proceeding according to Section 6 below – Optional QC and QV Asphalt Binder Content Comparison.

3 ***Reverification of the Ignition Oven Correction Factor***

Ignition oven correction factors recalculated during production may use plant-produced or lab-batched material. The party requesting reverification must notify the other party and provide one of the reasons listed in Table 2 above.

If the IOCF is being recalculated for reasons 1-6, proceed to Section 4 below, otherwise proceed to Section 5 below.

4 ***Witnessed Reverification***

The contractor and regional lab will coordinate the collection of ten individually packaged IOCF split samples of appropriate weight according to Table 1 above, label the samples with the information described in Section 2 above. The department delivers the IOCF samples to the regional lab within one day of collecting them. The contractor must deliver annual reverification IOCF samples to the regional lab at least 10 days before producing the mix design on a WisDOT contract. The regional lab sends three individually packaged IOCF samples for AC content verification to a department lab for automated extraction according to Section 6 below within one business day of receiving them.

For reverification reasons 1-5 in Table 2 above, the department determines the IOCF according to Section 6 below and the contractor determines an ignition oven asphalt binder correction factor and the appropriate aggregate correction factor for each mix design and oven according to WTM T308 Section A.

For reverification reason 6 in Table 2 above, the department determines the IOCF according to Section 6 below. The contractor may choose not to determine a new IOCF. If the contractor chooses to determine a new IOCF, the contractor determines

	an ignition oven asphalt binder correction factor and the appropriate aggregate correction factor for each mix design and oven according to WTM T308 Section A. The contractor must note on the percent binder control charts or running average report each time an IOCF is recalculated and the date the new IOCF becomes effective.
5	***Unwitnessed Reverification*** The contractor collects three individually packaged IOCF split samples of appropriate weight according to Table 1 above, and labels the samples as described in Section 2 above, and delivers the IOCF split samples to the regional lab within one day of collecting them. The department reserves the right to verify the asphalt content for each split sample provided to the regional lab according to WTM D8159. The contractor determines an ignition oven asphalt binder correction factor and the appropriate aggregate correction factor for each mix design and oven according to WTM T308 Section A. The contractor must note on the percent binder control charts or running average report each time an IOCF is recalculated and the date the new IOCF becomes effective.
6	***Verification of IOCF by Automated Extraction*** The department uses automated extraction to determine the asphalt content used to calculate the ignition oven asphalt binder correction factor for each oven, for each mix design, as follows: 1. The department performs one automated extraction according to WTM D8159 to determine an extracted asphalt binder content of the mixture. Results must be completed and reported by the end of the second business day after arrival at BTS. 2. The contractor has the option to run an automated extraction according to WTM D8159 or a chemical extraction according to AASHTO T164 Method A or B, for comparison to the result obtained by BTS. 3. If the contractor disputes the department's extracted asphalt content results, the following apply: 3.1. If results from both parties are within 0.40 % AC of each other, the department result is considered validated and will be used for the correction factor of all department ignition ovens. 3.2. If the two results are not within 0.40 % AC of each other, BTS will retest material from the same split sample. If the retest is within 0.20 % AC of the first department sample, the average of the two WisDOT test results will be used for the correction factor of all department ignition ovens. 3.3. If the retest does not meet the tolerance of 0.20 % AC, BTS will test a third split of the same sample and compare to the first two sample results. If the result is within 0.20 % AC of one of the first two tests, the average value of those two closest test results will be used for the correction factor of all department ignition ovens. 4. The regional lab will test two ignition oven calibration samples from the same split sample according to WTM T308.

	5. Once the regional lab has completed their ignition oven tests, they average the values obtained from their respective two tests and calculate the difference between that average value and the asphalt content provided by BTS determined from step 3 or 5, as applicable, to be used as the asphalt binder correction factor for that mix and oven. 6. Each ignition oven must have proper documentation indicating the following: contractor mix identification, date of ignition oven calibration, WisDOT 250#, mixture testing temperature, and correction factor. The contractor may compare their ignition oven results to the region's according to Section 7 below.
7	***Optional QC and QV Asphalt Binder Content Comparison*** The contractor has the option to compare their ignition oven results with those of the regional lab during production. An additional QC split sample may be collected with any random QV sample of each project for ignition oven asphalt binder content comparison testing between the contractor and regional lab. Results of the contractor portion of the comparison test are for information only and will not be added to the QC reported data for asphalt content. As a part of the ignition oven comparison test, the contractor will conduct a chemical extraction according to AASHTO T164 Method A or B or conduct an automated extraction according to WTM D8159. If the contractor and department test results from this comparison test differ by more than 0.40 % AC or if either test differs by more than 0.40 % AC from the contractor's chemical or automated extraction result, the QV-retained sample will be sent to BTS within one day for referee testing using automated extraction according to WTM D8159. The BTS referee test results will be used by the department and contractor to calculate a new IOCF for the mix according to Section 6 above using the remainder of the split sample material.

WTM M320

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO M320 ***Standard Specification for Performance-Graded Asphalt Binder*** with the following modifications:

AASHTO M320-21 (2021) Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R35 references with the following WisDOT Modified versions:* WTM R35 – Superpave Volumetric Mix Design
Table 1	*Delete Table 1 – Performance Graded Asphalt Binder Specification.* Instead, refer to the Combined State Binder Group specification.
Table 2	*Delete Table 2 – Performance Graded Asphalt Binder Specification Using Critical Temperature.* Instead, refer to the Combined State Binder Group specification.

WTM M332

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO M332 ***Standard Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test*** with the following modifications:

AASHTO M332-21 (2021) Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R35 references with the following WisDOT Modified versions:* WTM R35 – Superpave Volumetric Mix Design
Table 1	*Delete Table 1 – Performance Graded Asphalt Binder Specification.* Instead, refer to the Combined State Binder Group specification.

WTM R66

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO R66 ***Standard Practice for Sampling Asphalt Materials*** with the following modifications:

AASHTO R66-16 (2020) Section	**WisDOT Modification:**
1.1	*Replace Section 1.1 with the following:* This standard applies to sampling asphalt materials at production facilities, at storage facilities, or at the point of delivery. Samples may be taken from tanks, vehicles, or containers used for the storage or shipping of asphalt materials.
4.1.1	*Replace Section 4.1.1 with the following:* 1 L (1 qt) of asphalt binder/MC asphalt.
4.1.2	*Replace Section 4.1.2 with the following:* 2 L (2 qt) of emulsified asphalt.
4.2	*Remove Section 4.2 – Sampling semisolid or solid materials*
5.1.2	*Replace Section 5.1.2 with the following:* Containers for emulsified asphalts shall be a ½ gallon plastic utility jug with a handle and small cap, similar to Figure 1 (Uline S-13509B).
Figure 1	*Replace Figure 1 with the following:* 
6.1	*Replace Section 6.1 with the following:* Sample containers shall be new, clean and dry. The top and container shall fit together tightly.

6.4	*Replace Section 6.4 with the following:* Emulsified asphalt samples shall be protected from freezing. Samples shall not be exposed to direct sunlight for long periods of time. **NOTE 1 –** When sampling emulsified asphalt, do not sample material under pressure. Pressure may allow air entrapment, which could result in erroneous test results. Bubbles in the material are one indication that air has been entrapped. **NOTE 2 –** When filling a container with emulsified asphalt, fill the container to the top, or fill until a 1.5 to 2 inches space remains then squeeze the container to cause the contents to fill to the top to minimize the skin formation at the air-emulsion interface. Place the cap and securely tighten it. The space remaining will aid in the mixing the sample prior to testing.
6.7	*Add Section 6.7 with the following:* Emulsified asphalt samples should not be subjected to extended transit periods to reduce temperature fluctuations and constant motion.
7	*Remove section 7.*
8.1.1	*Add Section 8.1.1 with the following:* If sampling from a valve installed in the side or end of the delivery vehicle tank, the valve must be between the quarter points of the tank’s vertical diameter. Draw off and discard enough material to clear the intake line of material from previous loads before sampling. If bleeding through a drain-cock in the transfer line, allow at least 5 minutes between samples.
8.2	*Remove section 8.2.*
9	*Remove section 9.*
10	*Remove section 10.*
12	*Remove section 12.*
13	*Remove section 13.*
14.2	*Remove section 14.2*
14.3.1	*Remove section 14.3.1*

WTM R60

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO R60 ***Standard Practice for Sampling Freshly Mixed Concrete*** with the following modifications:

AASHTO R60-12 (2020) Section	**WisDOT Modification:**
5.1	*Replace Section 5.1 with the following:* *Size of Sample* – A minimum sample size of 1.2 ft^3 should be used when air and slump tests are performed, and 3 cylinders are cast for strength tests. Smaller samples may be permitted for routine air content and slump tests and may be taken after one-quarter cubic yard of concrete has been discharged.
5.2.6	*Add Section 5.2.6:* ***Sampling During Pumping Operations*** - When pumping concrete, there is a potential for a loss of entrained air. According to the specifications, the contractor is to ensure that the discharge end of the hose is kept higher than the lowest point of the hose. This can be accomplished by laying a portion of the flexible hose on the bridge deck, tying a partial loop in the end of the hose, or any other method approved by the project engineer. The project engineer may approve alternate methods if the contractor can demonstrate that the air loss in the concrete created by the pumping process does not exceed 1.0% in any boom orientation. Due to the potential for air loss, it is important to sample the mix from the point of placement, which is the discharge end of the pump line. This will ensure that the test results are a true representation of the in- place material. Due to the loss of air being dependent on the variable location or configuration of the pumping hose, it is generally not acceptable to use a correlation between the truck discharge and the end of the pump hose.
5.2.7	*Add Section 5.2.7:* ***Sampling During Conveyor Belt Placement*** - When placing concrete with conveyor belts, there is a potential for air loss due to the movement of the mix from belt to belt and from the belt to the point of placement. It is important to have test results that truly represent the in-place material. The specified air content is for the point of placement location and it is intended that sampling take place at the point of placement.
5.2.8	*Add Section 5.2.8:* ***Sampling During Underwater Placement*** - It is not possible to obtain a sample at an underwater point of placement. The contractor and project engineer should agree on a method and location of sampling. The sampling point should be as

	close as possible to the placement location, while ensuring the safety of testing personnel. It is important to document the sampling methods when not being performed at the point of placement.

WTM R100

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO R100 ***Standard Method of Test for Making and Curing Concrete Test Specimens in the Field*** with the following modifications:

AASHTO R100-21 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R60, T119 and T152 references with the following WisDOT Modified versions:* WTM R60 – Sampling Freshly Mixed Concrete WTM T119 – Slump WTM T152 – Air Content Type B
6.1	*Replace Section 6.1 with the following:* *Cylinder Specimens* – Compressive or splitting tensile strength specimens shall be 6 x 12-inch cylinders cast and allowed to set in an upright position. Cast a minimum of 3 cylinders.
6.2	*Replace Section 6.2 with the following:* *Beam Specimens* – Flexural specimen shall be 6 x 6 x 21-inch beams of concrete cast and hardened with the long axes horizontal. Cast a minimum of 3 beams.
10.1.2	*Replace Section 10.1.2 with the following:* Initially cure molded specimens at a temperature of 16 - 27°C (60°F - 80°F). Initially cure the molded specimens for 24 to 48 hours. If specimens cannot get transported to the final cure location within 48 hours, strip the cylinder mold at 24 ± 8 hours, then place it back into a proper lime-saturated curing water bath at a temperature of 22.5 ± 1.5°C (73 ± 3°F) according to AASHTO M 201, Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes. If specimens can be transported to the final cure location within 48 hours leave the specimens in place during transportation, then strip the molds when the specimens get to the final cure location. Specimens must be marked with the date and time the specimen were cast, the project number, and the specimen number.
11.1	*Replace Section 11.1 with the following:* After the 24 to 48 hour initial cure, the specimens will be transported to the laboratory to be stored under standard conditions. While in transport, the specimen must be protected from freezing or moisture loss. Specimen must also be secured so that the axis is vertical (held straight, up and down).

WTM T22

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T22 ***Standard Method for Compressive Strength of Cylindrical Concrete Specimens*** with the following modifications:

AASHTO T22-22 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R100 and ASTM C1231 reference with the following WisDOT Modified versions:* WTM R100 – Making and Curing Test Specimen in the Field WTM C1231 – Use of unbonded Caps in Determination of Compressive Strength
6.1.1.1	*Replace Section 6.1.1.1 with the following:* At a 12 month interval.
9.4	*Add Section 9.4:* Randomly select 2 QC specimens to test at 28 days. Compare the strengths of the 2 randomly selected QC specimens and determine the 28-day sublot average strength as follows: • If the lower strength divided by the higher strength is 0.9 or more, average the 2 QC specimens. If the lower strength divided by the higher strength is less than 0.9, break one additional specimen and average the 2 higher strength specimens.
10	*Replace Section 10. "Report" with the following:* The report should include: • Specimen identification number • Diameter (and length if outside 1.8 to 2.2 x diameter) • Cross-sectional area • Age of specimen • Date of test***** • Time of test***** • Rate of loading***** • Maximum load***** • Compressive strength calculated to 10 psi • Type of fracture, if other than the usual cone (see Figure 2) • Defects in either specimen or caps *AASHTO specifies the testing machine must be capable of automatically recording these four items.

WTM T24

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T24 ***Standard Method of Test for Obtaining and Testing Drilled Cores and Sawed Beams*** with the following modifications:

AASHTO T24-15 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO T22 and T97 references with the following WisDOT Modified versions:* WTM T22 – Compressive Strength of Cylinders WTM T97 – Flexural Strength of Beams
5.1.3	*Replace Section 5.1.3 with the following:* If it is not possible to prepare a test specimen that meets the requirements of Sections 7. 1 and 7.2 and that is free of embedded reinforcement or other metal on a structure or barrier, obtain BTS approval and if needed BOS approval prior to coring. If a core tested for strength contains embedded metal, the size, shape, and location of the metal within the core shall be documented in the test report.
7.1.2	*Add the following to Section 7.1.2:* For compressive strength cores not intended for determining pavement thickness, measure the longest and shortest lengths on the cut surface along lines parallel to the core axis. WisDOT specifications require to measure length to at least 0.1 in.
7.2.2	*Remove Section 7.2.2*
7.10	*Replace Section 7.10 with the following:* Report the results as required in WTM T22 with the addition of the following information: • Length of test specimen after capping. • Diameter of the specimen • Length to Diameter Ratio • Measured Peak Load • Correction Factor or “Not Applicable” • Corrected Compressive Strength • Direction of load application with respect to horizontal plane. • Moisture condition at time of testing whether saturated or air-dried. • Nominal maximum of concrete aggregate.

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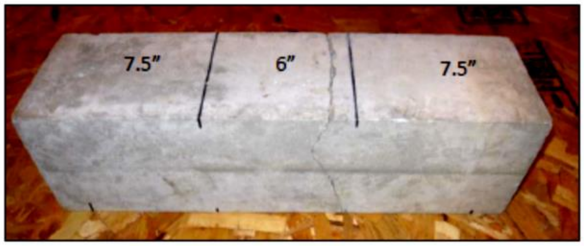
WTM T97

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T97 ***Standard Method of Test for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)*** with the following modifications:

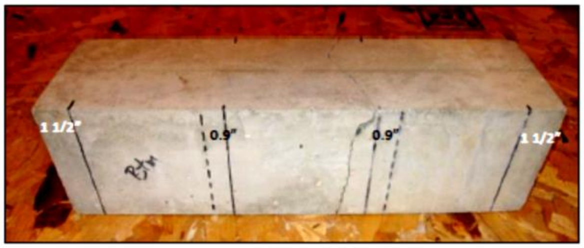
AASHTO T97-23 Section	**WisDOT Modification:**
2.1	Replace the AASHTO R100 and T22 reference with the following WisDOT Modified version: WTM R100 – Making and Curing Test Specimen WTM T22 – Compressive Strength of Cylindrical Concrete Specimens
5.1.2.1	*Replace Section 5.1.2.1 with the following:* Calibration of the testing machine used for flexure testing must be verified at a 12 month interval.
6.1.1	*Add Section 6.1.1:* Turn the specimen on its side with respect to molding when preparing to perform the test. Mark the bottom 1st. 1. Mark the specimen using a magic marker in a minimum of four locations: a. Once for each of the two load-applying blocks and once for each of the two support blocks. b. These marks will help when centering the specimen in the testing machine. 2. Four optional magic marker lines are recommended: a. Two lines defining the center third of the tension (bottom) surface. b. Two lines marking 5% outside the middle third of the tension surface. c. These marks will aid in identifying the correct formula to use when calculating test results. 3. Also place four tick marks on each side of the beam at the bearing block location.

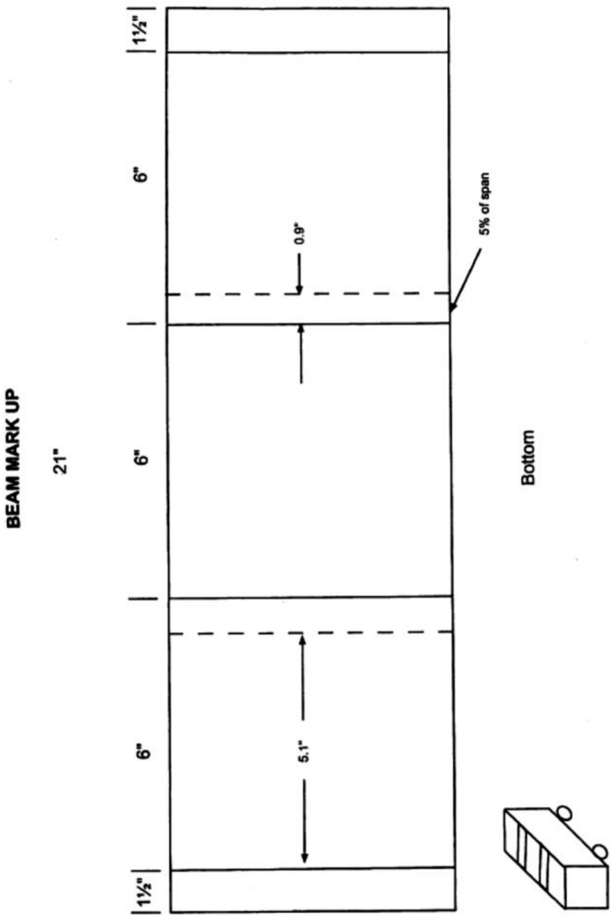
Marks on Top of Beam:



*Note: The above dimension is only used as double check, not to locate the marks

Marks on Bottom of Beam





<table>
<tr>
<td>7.1.1</td>
<td>
<p>Add Section 7.1.1:</p>
<p>All test specimens for a given test age shall be broken within the permissible time tolerances prescribed in Table 1:</p>
<table>
<tr><th>Test Age[1]</th><th>Permissible Tolerance</th></tr>
<tr><td>24 h</td><td>±0.5 h</td></tr>
<tr><td>3 days</td><td>±2 h</td></tr>
<tr><td>7 days</td><td>±6 h</td></tr>
<tr><td>28 days</td><td>±20 h</td></tr>
<tr><td>56 days</td><td>±40 h</td></tr>
<tr><td>90 days</td><td>±2 days</td></tr>
</table>
<p>[1] For test ages not listed, the test age tolerance is ±2.0% of the specified age.</p>
<p>Unless otherwise specified by the Department for this method, the test age shall start at the beginning of casting specimens.</p>
</td>
</tr>
<tr>
<td>9.4</td>
<td>
<p>Add Section 9.4:</p>
<p>Randomly select 2 QC specimens to test at 28. Compare the strengths of the 2 randomly selected QC specimens and determine the 28-day sublot average strength as follows:</p>

If the lower strength divided by the higher strength is 0.9 or more, average the 2 QC specimens.
If the lower strength divided by the higher strength is less than 0.9, break one additional specimen and average the 2 higher strength specimens.

</td>
</tr>
<tr>
<td>10.1.6</td>
<td>
<p>Replace Section 10.1.6 with the following:</p>
<p>When the average of two or more companion beams tested at the same age is reported, calculate the average Modulus of Rupture using the unrounded individual Modulus of Rupture values. Report the average Modulus of Rupture rounded to the nearest 0.05 MPa (5psi).</p>
</td>
</tr>
</table>

WTM T119

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T119 ***Standard Method of Test for Slump of Hydraulic Cement Concrete*** with the following modifications:

AASHTO T119-23 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R60, R100 and T152 references with the following WisDOT Modified versions:* WTM R60 - Sampling Freshly Mixed Concrete WTM R100 - Making and Curing Test Specimens WTM T152 – Air Content Type B
5.1.2 & 5.1.2.1	*Remove Sections 5.1.2 & 5.1.2.1 – Molds with Alternative Materials*
5.3	*Replace Section 5.3 with the following:* *Measuring Device*—A ruler, metal roll-up measuring tape, or similar rigid or semi rigid length measuring instrument, that starts at "zero" inches, marked in increments of 0.25 in. (5mm) or smaller. The instrument length shall be at least 12 in. (300mm). Do not use a portion or section of a metal roll-up tape.

WTM T121

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T121 ***Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete*** with the following modifications:

AASHTO T121-19 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R60, R100, T119, T152 references with the following WisDOT Modified versions:* WTM R60 – Sampling Freshly Mixed Concrete WTM R100 – Making and Curing Concrete Test Specimens WTM T119 – Slump of Hydraulic Cement Concrete WTM T152 – Air Content of Freshly Mixed Concrete by the Pressure Method
8.5	*Remove Section 8.2 – Air Content*
9.1.8	*Remove Section 9.1.8 – Air Content*

WTM T152

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T152 ***Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method*** with the following modifications:

AASHTO T152-19 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R60, R100 and T119 references with the following WisDOT Modified versions:* WTM R60 – Sampling Freshly Mixed Concrete WTM R100 – Making and Curing Concrete Test Specimens WTM T119 – Slump
3.1	*Add the following to Section 3.1:* Except for light weight concrete mixtures, the department allows only type B and SAM meters to be used to determine air content.
4.1	*Add the following to Section 4.1:* Except for light weight concrete mixtures, the department allows only type B and SAM meters to be used to determine air content.
5.1	*Replace Section 5.1 with the following:* The following table are the requirements and intervals for Type B and SAM meter calibration, standardizations and checks. All records shall be kept with the device.

Item	Process	Frequency
Calibration	Calibrate the type B or SAM meter using the procedures in WTM T152 – Annex C or D. Run the test in calibration mode.	Minimum of every three months during production. OR Whenever maintenance is performed.
Check	Verify the air meter using WTM T152 – Annex B or C.	Once a week.
Annual Maintenance	• Tension of the clamps* • Weigh the air pot • Check the volume of the lower chamber • Schrader Valve* • Pet cocks*	At a minimum, once a year.

		• One way valve on the pump* • Check the gaskets • Check the gasket mating surface	*Items will require more frequent maintenance throughout production
5.1.1	*Add the following to Section 5.1.1:* All air meters must have a means of identification so that calibration records and calibration canister check tests records can be related to the specific air meter those records represent.		
5.2.1	*Follow Section Annex B for Field Check Test of Air Meters Using a Calibration Canister, Annex C for Pro Cali Can Air Content Verification Procedure and Annex D for Calibration of Pressure Air Meter.*		
Annex B	*Add Annex B with the following:* **Field Check Test of Air Meters Using a Calibration Canister:** The calibration canister check test should never be used to calibrate an air meter. Air meter calibration must be performed by the water method prescribed in WTM T152 at three points within the anticipated range of testing. Since the calibration canister only gives one point of reference in checking the accuracy of an air meter it is suggested that a check on the accuracy of the Initial Pressure Line also be performed in conjunction with the check performed using the calibration canister. This should be performed per AASHTO T152 requirements to ensure that introducing the pressure to the air meter bowl from the air chamber pumped up to the initial pressure would result in a zero reading on the air pressure gauge. For checking the accuracy at the high end of possible air test results, two calibration canisters may be used, and the results should be consistent with the total air percentage represented by the calibration canister used. The procedure for testing the accuracy of the air meter using a calibration canister is as follows: 1. Locate the air meter bowl on a firm horizontal (level) surface. 2. Fill the bowl with clean water. It is recommended that the water sit for several minutes before use. This will allow air entrained in the water to dissipate. 3. Place the calibration canister upright at the bottom of the water filled air meter bowl. 4. Add water to the bowl to the point of just overflowing. 5. Place the cover (lid assembly) on the bowl and latch it down. Make certain the main air valve is closed. 6. Add water through the funnel or petcock until the meter is completely full. Gently jar the meter and tap on the sides of the bowl until no air bubbles come out the petcock. 7. Pump up pressure until the gauge needle comes to the vicinity of the red line.		

8. Stabilize the gauge hand at the initial pressure line (yellow/red hand on Soil Test or White type meters, gauge line on Forney type). This is done by using the air bleeder valve.
9. Close both petcocks on the lid. Open the main air valve, tap the gauge and allow the gauge hand a few seconds to stabilize. The gauge reading should be that established for the calibration canister (see below). A reading +/- 0.2% is considered to be acceptable.
10. If the reading exceeds the suggested tolerances a second trial should be done. Meters that read over +0.2% after a second trial or under -0.2% on the first trial should be removed from service and repaired and recalibrated as appropriate.

The calibration canisters are suitable for use with any 1/4 cubic foot (0.007 m^3) air meter. The manufacturer usually establishes the canister to be equal to 5% by volume, but experience has shown the actual value to be slightly different. This is caused by difference in atmospheric pressure or elevation the calibration canister was operated within. It is suggested that the actual percentage of each calibration canister be determined on a meter that has been water-calibrated according to WTM T152 at three different percentage points within the anticipated range of testing through at least three repetitive tests using a calibration canister that indicate a repeatable result. An equivalent volume can be determined based on the actual volume of the meter that the calibration canister percentage was based on. Calculate the equivalent volume of the calibration canister by multiplying the volume of the bowl by the determined calibration canister percentage divided by 100. When testing is repeated using a calibration canister the canister must be removed and any water that has remained in the canister must be removed before any subsequent tests.

Example 1:

Volume of the air meter bowl = 7050 mL Indicated calibration canister results = 4.8%

Calibration canister equivalent volume = 7050 X 4.8/100 =338.4 mL

When a calibration canister is used in a meter with a different volume, the percentage of the calibration canister for that meter can be determined by dividing the equivalent volume calculated for the calibration canister by the volume of the air meter bowl being checked.

Example 2:

Volume of air meter bowl being checked = 7075 mL Equivalent volume of the calibration canister = 338.4 mL

Percent of volume of meter tested = 338.4mL/7075mL X 100 = 4.78%

Volume variations between air meter bowls would need to be significant to show a +/- 0.2% difference in the indicated results compared to the calculated results using the equivalent volume.

Annex C

Add Annex C with the following:

Pro Cali Can Air Content Verification Procedure:

The Pro Cali Can is a useful tool to calibrate concrete air meters that use pressure. Each Pro Cali Can is manufactured to represent 5.0% air content when placed in a Type B Meter or Super Air Meter (SAM) filled with water. The method below will describe how to verify the Pro Cali Can's calibrated air volume.

1. Inspect and make note of the condition of the Cali Can.
    - Inspection notes should include any damage, build up or other observations.
2. Use a calibrated Type B meter or calibrated SAM.
    - It is recommended to run a calibration on the SAM with the desired Cali Can prior to the verification process.
3. Fill the bowl up with water and carefully place the dry Cali Can in the bowl.
    - Ensure the Cali Can is inserted as vertical as possible when placing in water.
    - It is recommended to place the Cali Can on the intended pivot point to avoid the can from falling over during the removal of air under the lid.
4. Dampen the O-Ring and bottom of the lid of the air meter and clamp the lid to the bowl.
5. Use a funnel or syringe to remove excess air trapped underneath the lid.
    - The use of a funnel is preferred whenever possible.
    - Failure to remove most of the air under the lid will lead to false air content readings.
6. Tip the air meter carefully to assist with the removal of air underneath the lid so that the Cali Can does not fall over in the bowl.
7. Close both petcocks and follow the relevant instruction below:
    - Type B Meter: Pressurize the meter to the calibration line and let stabilize.
    - SAM Meter: Run the SAM in Type B Mode and pressurize to 14.5 psi and let stabilize. It is acceptable to run it in SAM Mode. Only run the first pressure step (14.5 psi) if in SAM Mode.
8. Once a stable pressure is established, hold the lever down and let the pressure equalize.
    - On the SAM, short press 'Enter' once the pressure has equalized. Once the gauge verifies the pressure is stabilized, hold the lever down and short press 'Enter' again to progress through the rest of the test.
9. After equalization, record the air content the meter produces.
    - On the SAM, press 'Enter' again to read the air content.
10. Open the petcocks to release the pressure on the meter.
11. Repeat steps 5-10 an additional 2 times.
12. Record the air content on the subsequent runs.
13. Take the average of the 3 air content readings and round to the nearest 0.1%.
14. Remove the Cali Can from the air meter and let it dry.

15. Once the Cali Can dries, grab a different calibrated air meter and perform steps 3-11.
    - The other air meter can be another Type B meter or SAM
16. Once 3 air content measurements are obtained from the other air meter, take the average of the air contents recorded from that air meter.
17. Subtract the 2 air content averages obtained.
    - If the difference is less than or equal to 0.2%, then the Cali Can's air content is verified, and no action is needed.
    - If the difference is greater than 0.2%, follow the troubleshoot guidance.

Troubleshoot: Difference Greater than 0.2%

Air Meter Check

Check both air meters for leaks to ensure no leaks are present. If a leak was present on one or both of the air meters, repair the leak(s) and retest. If no leak is present, it is likely the Cali Can may need to be replaced or an error during testing occurred.

Mistake During Testing

It may be prudent to repeat the process again to ensure a mistake was not made during testing. There is a possibility the Cali Can may have not been placed properly in the bowl, or the Cali Can tipped over during testing. Another possibility is not enough air was removed under the lid. Any air that is trapped under the lid will be accounted for in the test. The last possibility is an accidental lever press during the pressurization step. Hitting the lever will introduce air under the lid which will then be accounted for in the test. If the difference is still greater than 0.2% after retesting, it is possible the Cali Can may need to be replaced or a meter was leaking.

Annex D

Add Annex D with the following:

Calibration of Pressure Air Meter Procedure

Apparatus:

1. Balance capable of weighting to 0.1% of the weight of the bowl filled with water.
2. Glass plate at least ¼ inch thick large enough to cover the flange of the bowl.
3. Container with the capacity to hold at least 700 grams or milliliters of water, such as a graduated cylinder.
4. A means of extracting water from the air meter such as straight and hooked tubes.
5. Three gallons of water set out at least one day before calibrating the gauge so it is at room temperature and deaired.
6. Air meter conforming to the requirements of WTM T152 Section 4.1.2.

Procedure:

1. Place a thin film of grease on the top flange of the bowl to insure a watertight seal between the flange and the plate. Weigh the greased empty air meter bowl alone. Weigh the air meter bowl and glass plate. Record these weights to the nearest gram and designate the second weight as weight “B”. Weigh the container (usually a graduated cylinder) used to hold the water removed from the air meter bowl to the nearest gram and designate as weight “E”.
2. Place a small shim such as a strike off bar that is approximately 1/8 inch thick at one side under the meter bowl tipping it to help direct air removal when filling bowl with water. Fill bowl with day-old water so the meniscus of the water is slightly above the low side of the bowl flange. Remove air bubbles on the side of the bowl using a strike off bar or similar object to wipe them off the sides.
3. Slowly tip the edge of the glass plate onto the bowl from the low side of the bowl flange and slide onto the bowl until the edge of the glass plate is slightly above the water line. Add water slowly with the tip of the syringe below the water surface to prevent injecting air bubbles while sliding plate so its edge stays just above the water line until full with no apparent air bubbles visible under the glass.
4. Dry the outside of the bowl and plate with a towel. Weigh the water filled air meter bowl with the glass plate to the nearest gram and record this as weight “A”.
5. Determine the weight of the water in the bowl by subtracting B from A. Record to the nearest gram and designate this weight as “C”.
    a. **Note 1:** 7 grams = 0.1% volume of bowl. Spilling only 7 grams of water causes a 0.1% error.
    b. **Note 2:** This weight can be used to calibrate the volume of the bowl.
6. Find the short piece of straight threaded pipe supplied in the meter case and screw it into the threaded petcock opening on the underside of the cover assembly.
    a. **Note 3:** Be very careful not to cross-thread the pipe because it is screwed in at an angle to the bottom of the cover. The pipe threads can be easily damaged.
    b. **Note 4:** Make a mental note or a marker indication so you know which petcock the straight pipe is attached to when the cover is on.
7. Make sure the pressure lever on the main air valve between the pressure chamber and the measuring bowl and the air bleeder valve in the end of the air receiver on the cover assembly are closed. Open both petcocks on top of cover assembly.
8. Moisten the bottom surface of cover assembly and O-ring to be attached to the bowl, center on the bowl, rotate slightly to secure a good seal between the cover gasket and the bowl flange and close the four toggle clamps by closing the opposite clamps at the same time.
9. Inject water into the threaded petcock with the pipe attached under the cover until water comes out of the other petcock. Continue this operation until no air bubbles are visible coming through the petcock. Rotating the

WTM T152

bowl in a circular motion about the base of the bowl and gently tapping the bowl will help to ensure that all air is expelled from the meter's bowl.

   a. **Note 5:** If you inadvertently inject water into the wrong petcock without the tube you will immediately get water out of the petcock with the tube.
   b. **Note 6:** Be careful not to jam the tip of the syringe into the petcock because when you stop squeezing it water will be sucked out of the meter and air will be sucked in. Similarly, do not allow the syringe to run out of water because you might inject air into the meter.

10. Pump air into the pressure chamber until the gauge needle is slightly past the IPL. Allow a few seconds for the compressed air to cool to normal temperature.
11. Tap the gauge gently with one hand and at the same time slowly crack the bleeder valve in the end of the air receiver and close bleeder valve when the gauge hand aligns exactly with the IPL. Verify that gauge needle remains on the IPL.
12. Close both petcocks and immediately open the main air valve by pressing the thumb lever. Lightly tap the pressure gauge by hand to stabilize the gauge. This step compensates for pressure drop due to flexing of the gauge under pressure during testing.
    a. **Note 7:** At this point, the gauge should read zero. If not, select a different IPL that results in the gauge reading zero. If the needle stops past zero, select a new higher IPL and rerun the check. If the needle stops before zero select a new lower IPL and rerun the check. As gauges age they flex more and more possibly resulting in an IPL higher than 5 which means the gauge and maybe the entire meter should be replaced. However, check for leaks first.
13. After the initial adjustment, slowly release the pressure by carefully opening the unthreaded petcock **without the pipe** attached. Do not release pressure by opening the bleeder valve. Open both petcocks and repeat steps 9 through 12 of this procedure. If further adjustment to the IPL is needed, repeat the above steps until at least two consecutive tests indicate a gauge reading of zero after the last adjustment.
    a. **Note 8:** Pressure can be left in the gauge after the second zero check is successful in preparation for Step #17.
14. Calculate the weight of water to remove by multiplying the weight of the water in the bowl (step 5 of this procedure) by the decimal percent of air that is within the normal operating range that the meter is expected to measure. Typical target percentages are 5%, 7%, and 9%.
15. Suck water out of the top of the petcocks using a bulb syringe.
16. Screw the hooked pipe into the petcock with the straight pipe attached under the cover.
17. You may have this weight from Step 1: make sure you weigh the container that will be used to catch water removed from the gauge. It is acceptable to tare the scale used to weigh the container and note it as zero on the worksheet.

  - a. **Note 9:** A 1000 ml graduated cylinder is typically used fo this purpose.

18. Using pressure in the meter from the zero check or pump up the meter then slowly open the petcock with the hooked pipe to remove water from the bowl. Control the water flow by very carefully adjusting how open the petcock is. Deposit water removed from the bowl into the container that's weight had been recorded in #16 of this procedure. Continue this operation until the weight of water in the container approximates the weight of water determined in step 13of this procedure. Care should be taken to ensure all water removed from the bowl is captured in the container.
    - a. **Note 10:** To determine the actual percentage of water removed, weigh the container containing the water extracted to the nearest g by subtracting the "Container Weight" from "Container and Water" weight. Label this weight "D". Calculate the percent of water removed using the following formula: D/C X 100. Record to the nearest 0.1% of water removed.
19. Once water has been extracted, open the petcock without pipe attached to release any pressure in the bowl. Then open the petcock with the hooked tube to allow water in the tube to flow back into the bowl.
    - a. **Note 11:** Failure to return water in hook tube to bowl can result in as much as a 0.25% error.
20. Run an air test by repeating steps 10 through 12 of this procedure. The gauge hand should now read the percentage of air calculated from step 13 of this procedure. It should be within ± 0.1% of the actual percent air in the container determined by removing water.
    - a. **Note 12:** If the difference between the calculated and gauge results are more than 0.1%, it is recommended to continue running the calibration check on all three target percentages before making adjustments to the gauge. This provides valuable information on how the gauge tracks through the entire range of test results so a more accurate adjustment can be made.
21. Remove water for the next target air content by repeating Steps 17 through 19 of this procedure.
    - a. **Note 13:** After the three target air content comparisons have been made, if it's decided that an adjustment to the gauge is needed, consult the manufacturer's instructions to determine the proper way to adjust the needle.

WTM T309

Effective with January 2025 Letting
Revised Date: 12/02/2024

Follow AASHTO T309 ***Standard Method of Test for Temperature of Freshly Mixed Portland Cement Concrete*** with the following modifications:

AASHTO T309-22 Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R60 references with the following WisDOT Modified versions:* WTM R60 – Sampling Freshly Mixed Concrete
7.3	*Add Section 7.3:* Immediately, prior to sampling the freshly mixed concrete, dampen the sampling container with water.

WTM T358

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow AASHTO T358 ***Standard Method of Test for Surface Resistivity Indication of Concrete's Ability to Resist Chloride Ion Penetration*** with the following modifications:

<table>
<tr><th>AASHTO T358-21 Section</th><th>WisDOT Modification:</th></tr>
<tr><td>2.1</td><td><i>Replace the AASHTO R100 reference with the following WisDOT Modified version:</i>
WTM R100 – Making and Curing Concrete Test Specimens</td></tr>
<tr><td>3.1</td><td><i>Replace Section 3.1 with the following:</i>
This test method consists of measuring the resistivity of 12 in. (300mm) nominal length and 6 in. (150mm) nominal diameter cylinders or cores by use of a 4-pin Wenner probe array. An alternating current (AC) potential difference is applied by the surface resistivity apparatus at the outer pins of the Wenner array generating current flow in the concrete. The resultant potential difference between the two inner pins is measured. The current used and resultant potential along with the affected sample area are used to calculate the resistivity of the concrete. The resistivity, in kilohms-centimeters (kQ-cm), has been found to be related to the resistance of the specimen to chloride ion penetration.</td></tr>
<tr><td>4.3</td><td><i>Replace Section 4.3 with the following:</i>
Use Table 1 below for interpretation of results.</td></tr>
<tr><td>Table 1</td><td><i>Replace Table 1 with the following:</i>
Table 1:
<table>
<tr><th>Chloride Ion Penetrability Classification[1]</th><th>Resistivity[2] (kohm*cm)</th></tr>
<tr><td>High</td><td><5.2</td></tr>
<tr><td>Moderate</td><td>5.2 – 10.4</td></tr>
<tr><td>Low</td><td>10.4 – 20.8</td></tr>
<tr><td>Very Low</td><td>20.8 - 207</td></tr>
<tr><td>Negligible</td><td>>207</td></tr>
</table>
[1] Established by ASTM C1202
21]Established by AASHTP TP119-19</td></tr>
<tr><td>4.4</td><td><i>Replace Section 4.4 with the following:</i>
The details of the test method apply to 6 in. (150mm) nominal diameter specimens.</td></tr>
<tr><td>6.1</td><td><i>Replace Section 6.1 with the following:</i></td></tr>
</table>

	Surface Resistivity Apparatus - Probe spacing on the apparatus needs to be 1 ½ in. (38mm). The measurement range needs to be between 1-1000 kΩ*cm. The measuring frequency of the apparatus needs to be between 10-1000 Hz.
6.2	*Replace Section 6.2 with the following:* Specimen holder needs to be made of non-electrically conductive materials.
8.1	*Replace Section 8.1 with the following:* A set is composed of a minimum of three samples. Sample preparation and selection depends on the purpose of the test. For evaluation of materials or their proportions, samples may be (a) cores from structures or from larger diameter cast cylinders, or (b) 6 in. (150mm) diameter cast cylinders. Cylinders cast in the laboratory shall be prepared following AASHTO R 39. Unless specified otherwise, moist-cure test samples for 28 days prior to testing (Notes 2 and J).
8.1.1	*Replace Section 8.1.1 with the following:* Accelerated Moist-Curing –Provide 7 days of moist-curing in accordance with AASHTO R 39 for specimens prepared in the laboratory or in accordance with the standard curing procedure of AASHTO R 100 for specimens prepared in the field. The first 7 days includes the initial 24-36 hour field cure. After 7 days of moist-curing, immerse the specimens for 20 days in a lime-saturated water at 38.0 ± 2.0°C (100 ± 3°F). On the 27th day immerse the specimens in accordance with AASHTO R 39.
Note 2	*Delete Note 2.*
8.2	*Replace Section 8.2 with the following:* Transport the cores or field-cured cylinders to the laboratory in a moist condition in a sealed watertight container (for example a cooler filled with water). After transportation to the lab, and prior to placing in a moist-cure condition, remove the mold lid.
10.1	*Replace Section 10.1 with the following:* On the 28thday, measure the surface temperature of the sample to ensure the sample is within the range of 20 - 25°C (68 - 77°F) using an infrared heat gun.
10.2	*Replace Section 10.2 with the following:* Remove the first sample from the moist room or water tank and transfer the sample to the sample holder with the 0-degree mark on top. The concrete sample shall be tested within 5 min of being removed from the moist room or water tank. Immediately clean the surface with a saturated sponge or towel. The surface shall be saturated surface dry (SSD) during testing.
Note 4	*Remove Note 4*

11.1	*Remove Section 11.1*
11.2	*Replace 11.2 with the following:* Calculate the average surface resistivity of the set. Do not round. Rounding will only occur after Section 11.3.
11.3	*Replace Section 11.3 with the following:* Calculate the resistivity using the following equation: $\rho=\lambda*\rho_m/k$, ρ_m = set averaged measured surface resistivity λ = 1.1 (the leeching correction factor when cured in lime-water tanks) k = 1.37625 (the probe and sample shape correction – used for only 6-inch cylinders and a probe spacing of 1.5-inches) After the corrections are applied to the set average, the resistivity of concrete is rounded to the nearest 0.1 kΩ-cm. The DT 2232 form performs these calculations automatically.

WTM T395

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Revised Date: 09/13/2023

Follow AASHTO T395 ***Standard Method of Test for Characterization of the Air-Void System of Freshly Mixed Concrete by the Sequential Pressure Method*** with the following modifications:

AASHTO T395-22 (2022) Section	**WisDOT Modification:**
2.1	*Replace the AASHTO R60, R100, T119 references with the following WisDOT Modified versions:* WTM R60 – Sampling Freshly Mixed Concrete WTM R100 - Making and Curing Test Specimen in the Field WTM T119 – Slump WTM T152 – Air Content – Type B
4.10	*Replace Section 4.10 with the following:* *MinT* – The MinT assembly includes the MinT and a battery operated internal vibrator. The MinT is shown in Figure 2 below. The battery operated internal vibrator must have a 1 ⅛ inch diameter vibrating head with a vibration speed between 12,000 – 14,000 VPM (200 – 233 Hz). 
4.12	*Add Section 4.12:* *Portable Air Compressor:* Portable air compressor capable of delivering air to the SAM during the pressurization procedure. The maximum fill rate shall be less than or equal to 1 ft^3/min (28 L/min).
5.1	*Replace Section 5.1 with the following:*

The following table are the requirements and intervals for equipment calibration, standardizations and checks. All records shall be kept with the device.

	Process	*Frequency*
Calibration	Calibrate the SAM meter using a calibrated Cali-can per WTM T152 – Annex C. Run the test in calibration mode. If not within ±0.2% of the calibrated Cali-can value, re-test. If not within ±0.2% of the calibrated Cali-can value on the re-test, make adjustments to the SAM meter and recalibrate until within the ±0.2%.	Minimum of every three months during production OR Whenever maintenance is performed
Check	Verify that the SAM meter using a calibrated Cali-can. Option 1: Run the test in Type B mode. Option 2: Run the first pressure step in SAM mode. If not within ±0.2% of the calibrated Calin-can value, re-test. If not within ±0.2% of the calibrated Cali-can value on the re-test, then make adjustments and calibrate until within ±0.2%.	Once a week
Annual Maintenance	• Tension of the clamps* • Weigh the air pot • Check the volume of the lower chamber • Schrader Valve* • Pet cocks* • One way valve on the pump* • Check the gaskets • Check the gasket mating surface	At a minimum, once a year. *Items will require more frequent maintenance throughout production

5.2 *Remove Section 5.2*

9.1.1 *Replace Section 9.1.1 with the following:*

Prepare the concrete sample as described in Section 8.1. Dampen the interior of the measuring bowl and place it on a flat, level, firm surface. Using the scoop described in Section 4.11, place a representative sample of the concrete,

	prepared as described in Section 8, in the measuring bowl in equal layers. Consolidate each layer by the rodding procedure (Section 9.1.2) or using the MinT (Section 9.1.3). Strike off the finally consolidated layer (Section 9.1.4). Rod concretes with a slump greater than 3 in. (75mm). Use the MinT with concrete with a slump less than 3 in. (25 to 75mm).
9.1.3	*Replace Section 9.1.3 with the following:* *MinT*- Place the concrete in the measuring bowl in two layers. The layers can be placed slightly larger than half the volume of the bowl but no more than two-thirds of the bowl's volume. Vibrate each layer for 50 seconds using a stopwatch to track the time elapsed. If the second layer does not fill the measuring bowl, place an appropriate amount of concrete to fill the missing volume and vibrate for an additional 10 seconds. Remove the measuring bowl from the MinT prior to strike-off.
9.2.1	*Replace Section 9.2.1 with the following:* *Timing*—The entire test shall be completed within 12 minutes. Once the test has started it shall be completed without stopping. The 12-minute time limit starts right after strike-off.
9.2.2	*Replace Section 9.2.2 with the following:* *Preparation for Test*—Thoroughly clean the flanges or rims of the bowl and the cover assembly so that when the cover is clamped in place a pressure-tight seal will be obtained. Assemble the apparatus. 'Zero' the gauge if the reading is +/- 0.02 psi. Perform the following LEAK TEST before operation. Top Chamber Leak Check: 1. Pressurize to 45.00 - 45.50 psi and let stabilize • Pressurization stabilization can take 10-30 seconds • If not stabilizing, check Shrader valve 2. Wait 5 minutes 3. If pressure has dropped by more than 0.15psi, the meter has a significant leak that needs to be addressed before testing Bottom Chamber Leak Check: 1. Fill bowl with water until it is full 2. Clamp the lit onto the bowl by engaging opposite clamps 3. Pressurize top chamber to 45.00 – 45.50 psi and let stabilize 4. Press level and allow to come to equilibrium pressure 5. Check petcocks for leaks while holding the lever 6. Record pressure • Remove funnel to check petcock 7. Wait 10 minutes 8. Hold lever again

	9. If pressure has changed more than 0.50 psi, the meter has a significant leak that needs to be addressed before testing It is prudent to perform this procedure prior to operation in case part replacement is required.
9.2.2.1	*Replace Section 9.2.2.1 with the following:* Close the air valve between the air chamber and the measuring bowl and open both petcocks on the holes through the cover. Use a funnel (rubber syringes and squeeze bottles are not allowed during the filling process), inject water through one petcock until water emerges from the opposite petcock. Incline the apparatus and rock back and forth while continuing to add water to remove any air bubbles above the concrete sample. Continue adding water with the funnel until water emerges air-free from the opposite petcock.
9.2.3.2.1	*Add the following to Section 9.2.3.2.1* Maintain the same extra pressure throughout all pressure steps before the equalization step. It is acceptable to be +/-0.01psi within that value. EXAMPLE: P1 = 14.53psi, P2 = 30.03psi, P3 = 45.03psi; carry +0.03psi throughout test. *Air Compressors* – disconnect air compressor from the meter before equalizing the pressure between the top chamber and the bowl for each presssrue step.
11.1.4	*Add Section 11.1.4 with the following:* Record the equilibrium pressure steps.

WTM C1231

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Follow ASTM C1231 ***Use of Unbonded Caps in Determination of Compressive Strength of Hardened Cylindrical Concrete Specimens*** with the following modifications:

ASTM C1231-15 Section	**WisDOT Modification:**
7.1	*Replace Section 7.1 with the following:* Unbonded caps must be used on both ends of a test specimen. Pad hardness shall be in accordance with Table 1.

WisDOT ASTM E3209

Effective with January 2025 Letting
Revised Date: 09/13/2023

Follow ASTM E3209 ***Standard Method of Test for Pavement Thickness by Magnetic Pulse Induction*** **with** the following modifications:

ASTM E3209-20 Section	WisDOT Modification:
11.3	*Add Section 11.3 with the following:* **Project Reference Plate:** The 1st plate within a paving stage will be the Project Reference Plate. Establish the standard reference plate thickness by performing Sections 12.3 through 12.9 of this Modified WisDOT ASTM E3209. NOTE: A new reference plate thickness must be established for each MIT Scan machine used for testing. **Daily Testing of Reference Plate:** Test the project reference plate each day prior to taking project thickness measurements. If the daily project reference plate thickness is within 3mm of the standard reference plate thickness, proceed with project thickness testing. If the daily project reference plate thickness differs by 3mm or more of the standard refence plate thickness, perform troubleshooting and retest. If the re-test thickness is within 3mm of the standard reference plate thickness, proceed with project thickness testing. If the re-test thickness differs by 3mm or more of the standard project reference plate thickness, obtain a new MIT Scan machine and establish a new standard reference plate thickness.
12.1	*Replace Section 12.1 with the following:* Basic Units: Divide the pavement into basic units 250 feet long, measured along the pavement centerline. Treat fractional units less than 100 feet long as part of a contiguous basic unit. Special Units: Divide the pavement into a 350 square yard maximum area for each special unit. Place two test plates at random locations in each pavement unit prior to paving. Longitudinal and transverse test plate locations are determined randomly by the contractor using ASTM D3665, department approved spreadsheet, or calculator equipped to provide random numbers. When slip forming multiple lanes simultaneously, the plates can be placed at the same longitudinal random location within adjacent units. Place plates at least 3 feet from any steel or dowel bars. Relocate plates to a new random location if the original location is: • Over an active loop detector.

	• Where the depth will not be representative (such as a rut in the base). Relocate plates to the center of the panel if the original location is: • Within 3-feet of steel or an object containing steel. Fasten the plates to the base or subbase to prevent their movement during the paving operation. Record or mark the approximate location reference for the reflector for ease of locating after paving.
12.3	*Replace Section 12.3 with the following:* Once the pavement is sufficiently cured or compacted to support foot traffic, use the apparatus search mode to locate the reflector center. Obtain the contractor's plate locations from the Material Information Tracking (MIT) System. Designate plate locations with a sequential number and determine the center of each plate to within 2 feet. Determine which plate to test using Random Numbers. Before measuring, charge the battery if the voltage is less than 12 volts. Locate and mark the actual position of the place center using the gauge search mode. This search is performed by holding the gauge head 2 in. (50mm) to 3 in. (75mm) above the pavement and moving it side to side and forward and backward. When the apparatus search function is showing the strongest signal, place a mark directly above the reflector on the pavement with chalk or paint. See Fig. 1
12.4	*Add the following to Section 12.4:* Remove all debris from the surface of the pavement, using a scraper or broom where the gauge wheels will pass
12.5	*Add the following to Section 12.5:* Mark the actual position of the plate center as shown below.  **FIG 2 MIT Scan Device with front wheel in front of the reflector**
12.6	*Replace Section 12.6 with the following:* Press the MEASURE button and then *slowly* push the apparatus in a forward motion over the reflector. After the gauge head has traveled approximately 1.8 m [6 ft], the apparatus processor will calculate the thickness of pavement above the reflector.

13.4	*Add Section 13.4 with the following:* If the average of the three readings is > ¼ inch but <= 1inchfrom plan thickness, test the second plate in the unit. After testing the second plate, average the six results (3 from plate one and 3 from plate two) and express the result to the nearest 0.01 in. or 1mm.
14.1.9	*Add Section 14.1.9 with the following:* The contractor must enter the following plate data into the Material Reporting System (MRS) PCC module (136 Test Prefix): 1. Sequential test plate number. 2. The location of the test plate by one of the following methods: a. Station and Offset (entered manually) b. Latitude and Longitude (entered manually or uploaded with a tab delimited .txt file.) c. Northing and Easting (entered manually or uploaded with a tab delimited .txt file.) The department must enter all valid thickness measurements into the department's MIT system, using test report 136. If both plates are required to be measured, per Standard Spec, then all six thickness measurements will be averaged for that unit.
14.1.10	*Add Section 14.1.10 with the following:* The reference plate thickness will be recorded on form DT3209 MIT Scan Reference Plate. The contractor's reference plate thickness may be recorded on the DT3209 for informational purposes.

WisDOT Test Procedure (WTP) C-001

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WisDOT Test Procedure for Concrete Mixing Water

This procedure is comprised of testing for Acidity, Alkalinity, Sulfate, Chloride and Total Solids & Inorganic Matter. A sample must have passing results for all five tests to be considered acceptable for use in concrete.

<table>
<tr><th>Section</th><th>WisDOT Procedure:</th></tr>
<tr><td>1.</td><td>***Sampling***</td></tr>
<tr><td>1.1</td><td>Concrete mixing water sample container shall be a plastic utility jug with a handle and small cap. Sample a minimum of ½ gallon of mixing water.</td></tr>
<tr><td>2.</td><td>***Acidity Test***</td></tr>
<tr><td>2.1</td><td>Pour 200 mL of sample water into a 400 mL beaker.</td></tr>
<tr><td>2.2</td><td>Place the beaker on a stirring plate, place magnetic stirring rod, and start stirrer.</td></tr>
<tr><td>2.3</td><td>Add several drops of bromocresol green indicator solution.</td></tr>
<tr><td>2.4</td><td>Refer to Table 1 below for interpretation of bromocresol green test before proceeding.</td></tr>
<tr><td>Table 1</td><td>
<table>
<tr><th colspan="3">Bromocresol Green Test Interpretation</th></tr>
<tr><th>Colorimetric Observation</th><th>pH</th><th>Interpretation</th></tr>
<tr><td>Blue</td><td>>5.4</td><td>Solution is Alkaline. Record 0mL of NaOH and proceed to Alkalinity Test (Section 2.)</td></tr>
<tr><td>Green</td><td>3.8<pH<5.4</td><td rowspan="2">Dispose of sample and proceed to methyl orange test (Section 1.5)</td></tr>
<tr><td>Yellow</td><td><3.8</td></tr>
</table>
</td></tr>
<tr><td>2.5</td><td>If the solution does not turn blue dispose of the solution and repeat Sections 1.1 and 1.2. Add 1.0 mL to 2.0 mL of methyl orange indicator solution to turn the sample orange.
NOTE: Methyl orange solutions are yellow when they have a pH near 4.4 and are red when they have a pH near 3.1.</td></tr>
<tr><td>2.6</td><td>Using a bottle top dispenser, add 0.005M NaOH to the sample, in 5 mL increments. Wait several seconds between pumps to observe a potential color change.</td></tr>
<tr><td>2.7</td><td>Record the amount of 0.005M NaOH added to the sample when it turns yellow.</td></tr>
</table>

2.8	If no more than 40 mL (8 pumps) of NaOH was used when the sample turned yellow, the sample is considered passing. Therefore, the sample is considered acidic, and record 0 mL for the alkaline test.
2.9	If more than 40 mL of NaOH was used before the sample turned yellow, proceed to the Alkalinity Test (Section 2.).
3.	***Alkalinity Test***
3.1	Using the same sample from the Acidity test, add 0.02M HCl to the sample, in 5 mL increments. Wait several seconds between pumps to observe a potential color change.
3.2	Record the amount of 0.02M HCl added to the sample when it turns yellow.
3.3	If no more than 75 mL (15 pumps) of HCl was used when the sample turned yellow, the sample is considered passing.
3.4	If more than 75 mL of HCl was used before the sample turned yellow, the sample is considered failing.
4.	***Sulfate Test***
4.1	Pour 25 mL of sample water into a container.
4.2	Add one sulfate reagent pack and mix by gently agitating the sample.
4.3	Pour sample into 25 mL graduated cylinder and insert sulfate plastic disc indicator. Use the materials provided in the testing kit.
4.4a	If black dot is automatically visible, record 0 mg/L. The test is complete, proceed to the Chloride Test (Section 4).
4.4b	If the black dot is not automatically visible, raise plastic indicator until it becomes visible and record the sulfate concentration (mg/L). If the sulfate concentration is greater than 500 mg/L the sample is failing.
4.5	If the black dot cannot be seen within the measurable range of the indicator, proceed to performing the HI 38001 Sulfate Low and High Range Test kit (Sections 3.6 below).
4.6	HI 38001 Sulfate Low and High Range Test Kit:
4.6.1	Remove the cap from the plastic vessel from the testing kit. Fill the vessel with 15 mL of the sample (up to the mark).
4.6.2.	Add 1 packet of HI 38001 A-O sulfate reagent to the vessel. Replace the cap and swirl gently to dissolve.

4.6.3	Add 2 drops of complexing agent to the vessel and swirl to mix.
4.6.4	Add 1 drop of HI 38001 C-0 sulfate reagent to the vessel, and swirl to mix. The solution will turn violet. Replace the cap.
4.6.5	Insert syringe tip into the HI 38001 B-0 LR titration solution and pull the plunger out until the lower edge of the black plunger seal is on the first graduation mark (zero) on the syringe body.
4.6.6.	Place the syringe tip into the cap port of the vessel. Slowly add the titration solution drop by drop, swirling and waiting a few seconds after each drop. NOTE: The solution becomes turbid, but this reaction will not affect the result.
4.6.7.	Continue adding the titration solution until the solution in the container changes from violet to blue.
4.6.8	Read off the millimeters of titration solution from the syringe scale and multiply by 1000 to obtain mg/L (ppm) of sulfate.
4.6.9	Record the sulfate concentration. If no more than 500 mg/L, the sample is considered passing, proceed to the Chloride Test (Section 4.). If more than 500 mg/L was used, the sample is considered failing
5.	***Chloride Test***
5.1	Pour 100 mL of sample water into a 250 mL beaker.
5.2	Place beaker on stirring plate, place magnetic stirring rod, and start stirrer.
5.3	Add one chloride indicator powder pillow. Solution will turn yellow.
5.4	Add silver nitrate solution with titrator until solution turns orange. NOTE: If using a digital titrator it must be calibrated before use. Then reset digital counter to zero.
5.5	Record the amount of silver nitrate dispensed from the titrator. If no more than 1050 mg/L is used, the sample is considered passing, proceed to the Total Solids and Inorganic Matter Test (Section 5.). If 1050 mg/L or more is used, the sample is considered failing.
6.	***Total Solids and Inorganic Matter Tests***
6.1	Wash and dry a platinum dish in a 100°C oven. Record the weight of the platinum dish using an analytical balance. Turn on heating plate or Bunsen burner, place platinum dish on heat source.

6.2	Use a graduated cylinder to measure 100mL of the sample water. Pour the 100mL of sample water into the platinum dish.
6.3	Boil the sample until it completely evaporates, but make sure to pay special attention to the sample in the last fifteen minutes of boiling.
6.4	As soon as the last bit of water has boiled out, immediately put the platinum dish in a pan and place the pan in a 100°C oven for 1 hour.
6.5	Weigh sample and dish after 1 hour at 100°C to measure the amount of organic solids.
6.6	Place in 550°C oven for 1 hour.
6.7	Weigh sample and dish after 1 hour at 550°C to measure the amount of inorganic solids.
6.8	The mass of the residue in grams is equal to the percentage of total solids in the water since we used a 100ml water sample.
6.9	If no more than 0.04% of organic solids and 0.15% of inorganic solids remains, the sample is considered passing.
7.	**Strength Evaluation**
7.1	The strength evaluation for mixing water compares the compressive strength of 50-mm mortar cubes made with distilled water and the mixing water.
7.2	For mortar batches use concrete sand complying with ASTM C778. Mortar cubes must be prepared in accordance with ASTM C109. Batch size must be greater than the quantity required for strength test specimens.
7.3	Prepare at least three 50-mm mortar cubes for each batch. Strength test specimens shall be standard cured in accordance with test method C109.
7.4	Strength of mortar cubes shall be determined at 3 and 7 days in accordance with test method C109.
7.5	Compressive strength of mixing water mortar cubes must be within 10% of the strength of the distilled water mortar cubes at the 3 and 7 day breaks.

WisDOT Test Procedure (WTP) C-002

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WisDOT Test Procedure for Concrete Probing

This procedure is for determining the thickness of freshly placed, special unit, slip-form concrete pavement using a probing device.

Section	WisDOT Procedure:
1.	***Apparatus***
1.1	A probing device shall consist of both the rod and the top plate: • The probing rod shall be a non-flexing rod with a minimum diameter of ⅜ in. (10mm) and of such length as to completely penetrate the pavement to be measured. • The top plate shall be circular or square with a minimum area of 16 square inches. The top plate shall be at least 1/16 inch thick and sufficiently ridged to maintain a surface planeness of at least 1/8 inch across the widest dimension intended to be in contact with the concrete pavement surface. A hole shall be centrally located and of diameter as to allow for easy maneuvering along the length of the probing rod. It shall be fitted with a locking device so when locked to the probing rod, the angle between the top plate and probing rod will be 90 degrees.
1.2	A base plate shall conform to either: • ASTM E3209-20 concrete pavement reflector • Circular or square with a minimum area of 80 square inches and of such rigidity, when in place, to allow for the probing rod to be pushed against it without flexing.
1.3	Base plate fasteners shall be nails or epoxy. Optional nails are: bridge common, galvanized, and coated nails as well as masonry nails up to 3.5 in. (89mm).
1.4	A bridge shall be used that will span the full width of the freshly laid concrete. A bridge shall support a person without damaging the surface, as to allow for the use of the probing device.
1.5	A tape, ruler, or other measuring device of sufficient length shall be used to measure the depth of penetration of the probing device into the plastic concrete pavement.
2.	***Procedure***
2.1	Place two test plates at random locations in each slip-form pavement special unit before paving. Special units are a maximum of 350 square yards of concrete pavement per unit. Test plate locations are determined randomly using ASTM

	D366, department approved spreadsheet, or calculator equipped to provide random numbers.
2.2	Place the base plates at the selected locations and secure. If nails are used, then use a single nail in the hole in the center of the steel reflector. Note the locations of the base plates so they can be found after the paver has passed.
2.3	Position the bridge at the selected longitudinal location and locate plate.
2.4	Assemble the probing device. Keep the probing rod perpendicular to the pavement surface and insert the rod into the plastic concrete until the rod strikes the base plate.
2.5	Slide the top plate down the probing rod until it makes contact with the pavement surface and lock to the probing rod.
2.6	Withdraw the probing device. Measure the length of the probing rod inserted into the plastic concrete from the underside of the top plate to the end of the probing rod. Record this measurement to the nearest 1/8 inch.
2.7	Locate the second plate and repeat steps 4, 5, and 6.
3.	***Report***
3.1	Average the measurements from both plates. Record the average to the nearest 1/8 inch.
3.2	Report the average of the two readings as the thickness of the special unit being measured. Record the average measurement in MIT Prefix 135 report.

WisDOT Test Procedure (WTP) C-003

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WisDOT Test Procedure for Concrete Preplacement Measurement for Thickness

This procedure is for determining the thickness of special unit, nonslip-form concrete before material placement.

Section	WisDOT Procedure:
1.	***Apparatus***
1.1	• Stringline • Tape or other measuring device of such length as to measure the depth from bottom of stringline to top of base aggregate. Measurement device to be accurate to 1/8 inch • Concrete form pin(s) (as needed) • Chaining pin(s) (as needed) • Heavy weight (as needed).
2.	***Procedure***
2.1	Special units are a maximum of 350 square yards of concrete per unit. Measure cross section (short dimension of area) thickness at locations listed below before concrete placement: • One measurement at the start of the area • One measurement at the end of the area • Measurements approximately every 10 feet cross sectionally over the area. Measure thickness by: • Measuring the top of adjacent concrete slabs and top of forms to the base aggregate surface. • Measure interior areas by stretching a stringline across the top of forms and adjacent slabs. Measurements are to be determined from bottom of the stringline to the top of grade. Mark measurement locations with non-permanent marking medium.
2.2	If all individual thickness measurements meet or exceed plan thickness, select 2 random locations and record these measurements for the special unit.
2.3	Report thickness measurements that do not meet plan thickness to the contractor immediately. Contractor to address thickness corrections by reshaping the base aggregate.

2.4	After thickness corrections have been completed, repeat step 2.1 thru 2.3
3.	***Report***
3.1	Record random location measurements in MIT Prefix 135 report. Measurements are to be reported to the nearest 1/8 inch.
3.2	For sidewalks and driveways, depth is measured by project staff and may be recorded in MIT Prefix 155 report.

WisDOT AASHTO T65

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Follow AASHTO T65 ***Standard Method of Test for Mass [Weight] of Coating on Iron and Steel Articles with Zinc or Zinc Alloy Coatings*** with the following modifications:

AASHTO T65-19 Section	**WisDOT Modification:**
4.2	*Remove Section 4.2 – Purity of Water*
4.3	*Remove Section 4.3 – Antimony Trichloride Solution*
4.5	*Remove Section 4.5 – Hydrochloric Acid*
4.6	*Remove Section 4.6 – Hydrochloric Acid (1+1)*
4.7	*Remove Section 4.7 – Sulfuric Acid (25+75)*
7.1	*Replace Section 7.1 with the following:* Strip the zinc coating from the specimens using concentrated hydrochloric acid (37% aqueous solution, sp gr 1.18 – 1.19).
7.2	*Replace Section 7.2 with the following:* Determine the mass [weight] of the specimens individually to the nearest 0.01 g, except for articles other than sheet or wire with a specimen mass [weight] greater than 125 g. For articles other than sheet or wire with a specimen mass [weight] greater than 125 g, determine the mass (weight) to at least the nearest 0.1 g. After determining the mass [weight], immerse each specimen singly in the stripping solution and allow to remain until the violent evolution of hydrogen has ceased and only a few bubbles are being evolved. The same solution may be used repeatedly until the time required for stripping becomes inconveniently long. The temperature of the stripping solution shall at no time exceed 38°C [100°F]. After stripping, wash the specimens by scrubbing them under running water, dip in hot water and dry thoroughly. Determine the mass [weight] of the specimens again, to the same precision as in the initial determination.

WisDOT Test Procedure (WTP) M-001

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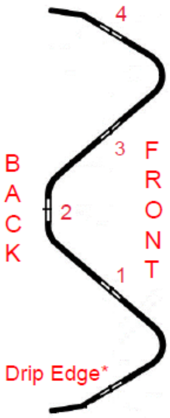
WisDOT Test Procedures for Beam Guard Coating Thickness Quality Verification

This procedure is comprised of the steps required for verifying coating thickness for steel plate beam guard.

Section	**WisDOT Procedures:**
1	*General*
1.1	Annually the WisDOT Regional Technical Services Section (TSS) will visit projects where beam guard has been installed to verify coating thickness.
1.2	Beam guard coating thickness verification must be performed for any contract that has 500 linear feet or more of beam guard installed. Test beam guard coating thickness for each manufacturer. *Note: If different manufacturers installed on contract, Project Engineer to supply locations to Regional TSS.* Beam guard coating thickness verification may be waived if less than 500 linear feet is placed on a contract.
2	*Apparatus*
2.1	PosiTector Model 6000 F
2.2	Calibration Equipment • Ferrous base metal disc • Blue calibration disc
3	*PosiTector Calibration / Verification Procedure*
3.1	<u>Calibration / Verification Steps:</u> **Performed prior to each use.** *Equipment needed: PosiTector and ferrous base metal disk.* 1. Press middle button to turn PosiTector on. 2. Press middle button then scroll to Cal Settings, press middle button to select. 3. Press middle button to select Zero. 4. Press (**+**) button to set number of readings to 10, probe sensor is ready (do not press middle button). 5. Press probe sensor flat to ferrous base metal disc. 6. Remove from metal disk when screen shows up arrow. 7. Press probe sensor flat to ferrous base metal disc again when screen shows down arrow.

	8. Continue until all 10 readings are complete. Average of the 10 readings must be 0 +/- 5 microns. 9. Place blue calibration disc on ferrous base metal disc. 10. Press probe sensor flat to blue calibration disc. Reading must be +/- 5 microns of established value indicated on the blue calibration disc.
4	*Thickness Verification Testing Procedure*
4.1	Randomly select a rail and test using the PosiTector Model 6000 F.
4.2	Thickness Verification Steps: 1. Press middle button to turn on PosiTector. 2. Press middle button to select Memory. 3. Scroll to New Batch, press middle button to select new batch. 4. Begin testing on randomly selected rail by pressing probe sensor flat to railing at locations listed in figure 1. A separate batch of measurements shall be taken at both ends of the selected rail. A batch of measurements for a verification test shall consist of 20 measurements, 5 each in locations 1 through 4 as shown in figure 1, spaced evenly between 1 and 3 feet from the end of the rail. Pay attention to possible outliers. If probe sensor not flat on railing may produce an erroneous high reading, delete, and retest at same location. 5. After completion of the first batch of 20 measurements from one end create a new batch for the other end of the same rail. 6. After completion of the second batch of 20 measurements and the average is above 80 microns, report results to Department Project Materials Coordinator (DPMC) who will proceed to reporting (see section 5). Proceed to section 4.4 if average is below 80 microns.
Figure 1	Beam Guard Railing Test Locations:  *Drip edge may be at the bottom, top, or end of rail. Look for indications of drips to determine where the drip edge is.
4.4	If the mean thickness measurement is below 80 microns, randomly select two additional rails from that heat/lot number and retest by taking additional batch

<table>
<tr><td></td><td>measurements at each end of the two rails. Mark the two retested rails for future reference.

If all four batches meet or exceed 80 microns, no further action is required; report results to (DPMC) who will proceed to reporting.

If any one of the four batches do not meet 80 microns, have the vendor cut three standard two foot samples from the original failing rail for testing at the BTS lab.

Report results to (DPMC) who will proceed to reporting.</td></tr>
<tr><td><i>5</i></td><td><i>Reporting (Completed by the DPMC)</i></td></tr>
<tr><td>5.1</td><td>Beam guard coating thickness verification testing must be reported on an MTS or MIT prefix 155 Miscellaneous Materials Report. Create a prefix 155 report for each manufacturer.

Prefix 155 report must contain the following:
Project Quantity of Beam Guard
Manufacturer
Installer
Bid Item Numbers & Descriptions on Project
Coating Thickness Verification Testing Information
Heat Number
Panel Length
Product Identification Number
Mean (Average) Reading (Min. 80 µm)
Tested By
Date Tested
Beam Markings & Quantity of each on the project.
Field Markings Recorded By
A template of the prefix 155 Beam Guard reference report can be found in the statewide pantry.</td></tr>
</table>