WSDOT Test Method T 716
Method of Random Sampling for Locations of Testing and Sampling Sites

A. Scope

1. This method outlines the procedure for selecting sampling and testing sites in accordance with accepted random sampling techniques. It is intended that all testing and sampling locations be selected in an unbiased manner based entirely on chance.

2. Testing and sampling locations and procedures are as important as testing. For test results or measurements to be meaningful, it is necessary that the sampling locations be selected at random, typically by use of a table of random numbers. Other techniques yielding a system of randomly selected locations are also acceptable.

B. Summary of Method for Selecting Random Test Location

• Method A – Determining a Random Location for Hot Mixture Asphalt (HMA) Density Tests
• Method B – Determining Random Test Location for Sampling HMA Mix, Aggregates, and Miscellaneous Materials
• Method C – Determining Random Test Location for Portland Cement Concrete
• Appendix A – Hot Mix Asphalt Density Test Locations for Irregular Paving Areas

C. Procedure for Determining Random Test/Sampling Location

Method A – Selection of Random Location for HMA Density

1. Stationing

This method outlines the procedure for determining the random location of HMA Density testing sites using stationing.

Calculate the linear foot distance for tons specified per sublot (i.e. 80 or 100 ton sublots).

Equations:

\[ Sublot \text{ length (ft)} = \frac{(Sublot \text{ quantity (tons)})}{(\text{width (ft)} \times \text{depth (ft)} \times 0.076 \text{ tons/cf})} \]

a. Use a random number generator (i.e. calculator, computer) or a random number determined by a stopwatch (See Note 1) to enter Table 1. Use the corresponding X value to determine the test station. A new X value is required for every test.

Note 1: To use the stopwatch method, randomly start and stop the stopwatch 10 or more times, then use the decimal part of the seconds as your entry point.

b. Determine the test station as follows:

\[ \text{Test Station} = (\text{sublot length} \times \text{“X” multiplier}) + \text{beginning station of paving} \]

c. Use a random number generator (i.e. calculator, computer) or a random number determined by a stopwatch (See Note 1) to enter Table 2. Use the corresponding “Y” multiplier to determine the offset. A new “Y” multiplier is required for every test.
d. Determine the offset as follows:

\[
\text{Offset} = (\text{width of pavement} \times \text{“Y” multiplier})
\]

Offset may be figured from the right or left edge of pavement. Tester shall indicate in MATS or approved density form from which edge the offset is measured.

e. When a testing location needs to be moved (i.e. for an obstruction or safety) the tester will adjust the location as follows:

i. For an adjusted of more than 2 ft, pick a new random number for the offset and recalculate the offset. Document the new location and the reason the testing location was changed.

ii. For adjustment of 2 ft or less move the gauge the required distance. Document the new location and the reason the testing location was changed.

Example for 100 ton sublot:

Given:
- Paving width = 12 ft
- Paving depth = 0.15 ft
- Beginning Station = 10 + 00
- Offset from left edge of pavement

Calculations:

\[
\text{Sublot length (mile)} = \frac{100}{(12 \times 0.15 \times 0.076)} = 730 \text{ lf}
\]

Ending Station = (Beginning Station + Sublot length) = (1000 + 730) = 17+30

Random generated number = X=25, Y=10

Beginning Test Location

Enter Table 1 at (25): “X” multiplier = 0.080

Enter Table 2 at (10): “Y” multiplier 0.167

Testing Station = (730 \times 0.080) + 1000 = 1058.4 = 10 + 58

Offset = (12 \times 0.167) = 2.00 = 2 ft left of pavement edge

2. Milepost

This method outlines the procedure for determining the random location of HMA Density testing sites using mileposts.

a. Convert to tons per mile using the roadway area based on the roadway width and depth.

Equations:

\[
\text{Sublot length (mile)} = \frac{\text{sublot quantity (tons)}}{\text{width (ft)} \times \text{depth (ft)} \times 401.28} \text{ tons/sqft/mile}
\]

Round sublot length to the nearest thousandth (0.001) of a mile

Calculate the location of the test site and offset using the same method as described in Method A Stationing except use tons per mile instead of the tons per lf.

Test site = (sublot length \times “X” multiplier) + beginning milepost

Offset = (width \times “Y” multiplier)
Example for 100-ton sublot:
Given:
Paving width = 12 ft
Paving depth = 0.15 ft
Beginning Milepost (MP) = 1.00
Offset determined from right side of pavement

Calculations:

Sublot length = $\frac{100}{(12 \times 0.15 \times 401.28)} = 0.138$

Ending MP = (Beginning MP + Sublot length) = (1.00 + 0.138) = 1.138

Random generated number = X=25, Y=90

Beginning Test Location
Enter Table 1 at (25): “X” multiplier = 0.080
Enter Table 2 at (90): “Y” multiplier = 0.060

Testing MP = (.138 × 0.080) + 1.00 = 1.011
Offset = (12 × 0.060) = 0.72 = 0.7 ft right of edge of pavement

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Random Number - Y

*Table 2*
Method B – Hot Mix Asphalt (HMA) Pavement Mixture or Aggregates

1. Determine the sublot increment of the material.
2. Use a random number generator (i.e. calculator, computer, etc) or a random number determined by a stopwatch (See Note 1) to enter Table 1. Use the corresponding X multiplier to determine the offset.
3. A new X multiplier is required for every sublot.
4. Random sample tonnage may be adjusted per sublot to accommodate field testing. Adjustments to random sample tonnage must be documented.
5. Calculate the location of the sampling site as follows:

   **Equations:**
   
   First Sample Site = Sublot increment × “X” multiplier (Table 1)
   Subsequent Sites= (sublot increment + (Sublot increment × “X” multiplier)

   **Example:**

   **First Sample**
   The computer-generated number is 22.
   Sublot Increment (Frequency of sampling) = 2,000 tons
   Enter Table 1 at (22) “X” = 0.700
   Sampling Site = 2000 × 0.700 = 1400 tons

   **Second Sample**
   The computer-generated number is (53).
   Sublot Increment (Frequency of sampling) = 2,000 tons
   Enter Table 1 at 53 “X” = 0.308
   Sampling Site = 2000 + (2000 × 0.308) = 2616 tons
Method C Portland Cement (PCC)

1. Sample the first two trucks.
   a. If the concrete, from the plant, meets all specifications, the testing frequency may be decreased to reduced frequency allowed by Standard Specification Section 6-02.3(5)G.
   b. If the first two truckloads of concrete did not meet all applicable specifications, testing will continue until two successive loads from the plant meet specification.

2. Determine subsequent random sampling locations as follows:
   a. Less than 10 truckloads remaining after reducing frequency:
      (1) Determine amount of pour remaining this will be the sublot increment
      (2) Use a random number generator (i.e. calculator, computer) or a random number determined by a stopwatch (See Note 1) to enter Table 1. Use the corresponding X multiplier to determine the test station. A new X multiplier is required for every test.
      (3) Determine the sample location as follows:
         Sampling Location = Concrete remaining × “X” multiplier (Table 2)
         Example:
         Total cubic yards (cy) of concrete placement = 80 cy
         Truckload = 10 cy
         Given: First two trucks are in specification = 20 cy
         Remaining cubic yards = 80 cy - 20 cy = 60 cy < 100 cy
         Sublot increment = 60 cy
         Random number = 30
         Sampling Location = 60 cy × 0.780 = 46.8 = 47 cy or 7th truck
   b. Greater than 10 truckloads remaining after reducing frequency
      (1) Determine the sublot increment for the random test sample.
      Sublot increment = cubic yards per truck × 10 truckloads
      Example:
      Pour = 130 cy
      Each truck carries 8 cy of concrete
      First two trucks are in specification = 16 cy
      Remaining cubic yards = 130 - 16 = 114 > 80 cy
      Sublot Increment = 8 cy × 10 trucks = 80 cy
      Use a random number generator (i.e. calculator, computer) or a random number determined by a stopwatch (See Note 1) to enter Table 1. Use the corresponding X value to determine the test station. A new X value is required for every test.
      Determine the sample location as follows:
      Sampling Location = Sublot increment × “X” multiplier (Table 1)
**Example:**

Random number = 15 “X” = 0.205  
Sample location = 80 cy × 0.205 = 16.4  
Determine where the first sample will be taken:  
Testing location = (accumulated cy of last truck sampled) + sample yardage

**Example:**

First Sample Location:  
Accumulated cy successive trucks = 8 × 2 = 16  
Sample location = 16 cy + 16.4 cy = 32.4 cy  
Truck load = 32/8 = 4  
Sampling = first half of 4th truck

Determine subsequent sampling locations as follows:

Sublot increment = total pour – (initial loads tested to get two consecutive loads in specification)-(first sublot increment)  
Sublot increment = 130 cy – (16 cy) – (80 cy) = 34 cy  
Random number = 70 “X” = 0.167  
Testing location = (initial loads tested to get two consecutive loads in specification) + (first sublot increment) + (testing location within the second sublot)  
Testing location = (16 cy)+(80 cy)+(0.167 × 34 cy)  
Testing location = 101.67 cy or 101.67/8 cy per truck = 12.7 = 13th truck

3. Report
   1. Report the random number used to determine station and offset
   2. Document any changes in station or offset of random testing location
   3. Use one of the following to report random location information:
      • Materials Testing System (MATS)
      • Form approved in writing by the State Materials Engineer
Appendix A

Hot Mix Asphalt Density Test Locations for Irregular Paving Areas

A. Track tonnage placed in the irregular shaped area until specified tons are placed, note the stationing.

B. Measure back to the beginning of the paving or end of the previous lot to obtain the length (this is also your beginning station).

C. Use a computer-generated random number or a random number determined by a stopwatch (See Note 1) to enter Table 1. Use the corresponding X value to determine the test station. A new X value is required for every test.

D. Multiply the length by the “X” value and add to the beginning station to locate your testing site.

E. Use a computer-generated random number or a random number determined by a stopwatch (See Note 1) to enter Table 2. Use the corresponding Y value to determine the offset. A new Y value is required for every test.

F. Measure the width at the testing station and multiply the width time the “Y” value to determine the offset of the testing site.

G. Make a sketch of the area to document the test location in the event a retest is required.

Example:

Paving began at Station 101 + 00.
The tester determined Station 105 + 75 was the end of the 100 ton lot.
The width of the pavement began at 0 and transitioned to 12.

Testing Station

Sta 105 + 75 – Sta 101 + 00 = 475 ft
Random number = 45, “X” value = 0.314
475 ft × 0.314 = 149.15 = 149
Testing station = 10100 + 149 = 102 + 49

Testing Offset

Measure width at station 102 + 49
Width = 3.76
Random # 65 “Y” value = 0.384
Offset = 3.76 × 0.384 = 1.44 = 1.4 ft from right edge